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I. DARWIN AND HIS TEACHINGS.

(Illustrated.)

It may seem strange to many thinking men, and to posterity it will doubtless appear inexplicable, that at this era in his history Man should still be obliged to approach with hesitation and reserve a subject so matter-of-fact as the Origin of Species, and that the publication of his views concerning his own animal nature and origin should always be accompanied by grave misgivings. But when we remember how few there are who can dissociate such inquiries from their religious creed, and with what reluctance such persons venture upon investigations that might have a tendency to shake the faith in which they have been educated; when we consider that many professors of theology conceive it to be their duty to foster these misgivings on the part of their "flocks," and to denounce men of science as instruments of the Evil one; then indeed it is not surprising that great courage should be needed for the exercise of unfettered thought and for the expression of what may be regarded as heterodox opinions. These checks upon the intellectual development of the human race, and this slow growth of free inquiry, are not, however, entirely without their advantages, nay, paradoxical as it may seem, they are in some degree essential to the steady progress of truth. The wisest men frequently err, and there are many who would have been thankful if an unfriendly critic had nipped some well-matured theory in the bud; the enterprising and impetuous reformer stands in greatest need of controlling agencies and adverse judgments; and the masses would remain stagnant and uninfluenced by men of thought and observation if these were continually pushing onward heedless of the difficulties and disdaining the shortcomings of the multitudes, whom they should seek to lead, and not to drive along the tortuous and thorny paths of discovery. Nothing, indeed, would be more unfortunate than if, at the present day, when man's thoughts outstrip his power of locomotion, there should be too great leniency in the judgment of new dogmas, for

there would soon be a transition from liberty to licence, which would inevitably be succeeded by a reaction fatal to progress. It appears wholly unnecessary to seek examples of the truth of these propositions, for who that will be at the trouble of thinking over the names of men conspicuous for their attainments in any department of human knowledge, in science, politics, or literature, can fail to alight upon numerous apt illustrations; but nowhere, we think, could a more perfect exemplification of what has here been advanced be found, than in the publication, reception, and influence of the teachings of Charles Darwin.

In one place we find the author and his theories vehemently denounced as subversive of all religious and moral truth; in another, he is held up as the founder of a new faith, and is almost deified by men who can see in nature nothing but a self-acting machine, whilst in Darwin, who is an apt student of nature, they manage to perceive a master-mind!

It has been chiefly urged against his theory of "Natural Selection," by persons otherwise disposed to adopt his Zoological doctrine, that he attributes too much to "Nature," and too little to God. "It has been said," he himself remarks,* "that I speak of natural selection as an active power or Deity, but who objects to an author speaking of the attraction of gravity as ruling the movements of the planets? Everyone knows what is meant and implied by such metaphorical expressions; and they are almost necessary for brevity." But this and other explanations or justifications which appear in the later, but not in the early editions of his master-work,† do not seem to remove what is decidedly the objectionable portion of his theory, nor to strengthen its weak points. We are not now speaking of the religious or irreligious tendency of the omission, but simply of the defect in his biological dogma, for, as we shall endeavour to show, "Natural Selection" is of itself not sufficient to explain the phenomena, past and present, of nature. Or, lest we should be met on the threshold of our inquiry by the objection that the illustrious naturalist does not claim for "Natural Selection" any such power, let us rather say that all the causes denoted by him, whether clearly, or (as it appears to us in some cases) ambiguously, are insufficient to produce even the phenomena included by him within the limits of his law, much less to accomplish those results which some of his disciples have justly stated, must follow as a matter of course from its admission, although he studiously avoids their nearer observation or discussion.

In these and other remarks upon Darwin's views, let it be clearly

* 'Origin of Species,' p. 85. (Murray.) Unless otherwise stated, our references will always be to the third edition, 1861.

† Compare, for example, 'Origin of Species,' first edition, p. 81, with third edition, pp. 84 and 85, where a paragraph is inserted; also, first edition, p. 83, with third edition, p. 87, where "natural selection" is substituted for "nature."

understood that we have no ambition to be reckoned among his censors; but whilst we admit his right of free speech, and applaud his fearless exercise of it, we feel quite justified, without rendering ourselves subject to the imputation of disrespect towards a great thinker and (judging from his works) a good man, in handling his dogmas without ceremony or reservation.

Whilst it is impossible not to perceive in his writings the dictates of a heart naturally reverential towards God and full of sympathy for his fellow-men,* there can be no doubt that the general body of his readers, whether lay or clerical, scientific or popular, must necessarily have received the impression that he endeavours to force the Deity out of sight, and to endow "Natural Selection" with Omnipotence and Omniscience. Take, for example, the following sentences from among many similar ones, which may be found even in the later and corrected edition of his work on the 'Origin of Species:'

"As man can produce, and certainly has produced a great result by his methodical and unconscious means of Selection, what may not *Natural Selection* effect? Man can act only on external and visible characters; Nature (*if I may be allowed thus to personify the natural preservation of varying and favoured individuals during the struggle for existence*) cares nothing for appearances, except in so far as they are useful to any being. She can act on every internal organ, on every shade of constitutional difference, on the whole machinery of life. Man selects only for his own good—Nature only for that of the being which she tends. Every selected character is fully exercised by her, and the being is placed under well-suited conditions of life."†

In the earlier editions, the word "Nature" stood for "Natural Selection," underlined in the foregoing extract, and the italicised sentence, intended to be explanatory of the latter term, was omitted altogether. Here, and in many other parts of his work, where the desire for "brevity" cannot be pleaded as an excuse, the author manifestly endows "Nature" with the intelligent faculty of designing and planning, and when it is remembered how rapidly (often indeed too rapidly) public criticism now follows the publication of new works; how these are *devoured* on their first appearance by literary gourmands before they can be carefully digested by experienced and thoughtful men of science, it will be clear that the new doctrine of Darwin must have borne with it an element far more antagonistic to its own universal acceptance than any that have since been associated with it by the more impetuous and indiscreet of

* See his 'Naturalist's Voyage round the World' (tenth edition, Murray, 1860), pp. 158, 500, 503; 'Origin of Species,' pp. 515, 525; 'On the Contrivances by which British and Foreign Orchids are Fertilized by Insects' (Murray), p. 2.

† 'Origin of Species,' p. 87.

his disciples, or than any obstacles that literary conservatism or sectarian intolerance may have thrown across its path.

And this is, indeed, much to be regretted on many grounds, not the least important being, that at the time when his views on the "Origin of Species" were first promulgated, the state of the public mind rendered great caution advisable in the publication of physical theories apparently opposed to religious tradition. The pruning-knife had been very ruthlessly applied to the tree of knowledge during the few years previous to the appearance of Darwin's book, and we know how at least one noble mind sank under the pressure of dogmas at variance with his previous theological beliefs. True, the large majority of thinking men, first savans, next laymen, and finally clergymen, had become reconciled to the new light which shone upon a world, now admitted to have been in existence ages of ages instead of a few thousand years, and the period of man's advent had also been removed to an earlier date than that assigned to it by tradition; but there were millions whose minds were still encrusted with the old doctrine, and thousands ready to seize upon any indiscretion on the part of natural philosophers, and to strangle the new-born infant of Science at its birth. But whilst all those facts which led to the revolution in men's minds concerning the six days' creation were clearly engraved upon the works of nature, and carried conviction to all who chose to observe and reflect, there is undeniably mixed up with the new law, or we should say, the recently revived doctrine of the transition of species a sufficiently large amount of speculation to preclude its acceptance otherwise than as a well-founded hypothesis. Many able men who have relinquished the biblical version of the creation, still, consciously or unconsciously, take their biological and zoological doctrines from the sacred writings, and some of these contend that the words "after his kind," and "after their kind," which so frequently occur in the first chapter of Genesis, mean the special creation, by a supernatural or miraculous intervention of the Almighty, of each new species, and of course to such reasoners there is no difficulty in accounting for the origin of man in conformity with the traditional account of his creation. Others, again, who are opposed to Darwin's views, do not base their opposition upon Scripture alone, but they say, and truly, that no new species has ever been known to come into existence either by natural or by artificial selection within the historic period, notwithstanding that experimentalists have, with one purpose or another, succeeded in breeding or producing innumerable widely divergent *varieties* of existing species.

But although the twofold nature of the argument against Darwin's views has told heavily against their acceptance, we believe reflecting men will soon find that the opposition on theological grounds cannot hold its place, and that it resembles in its character

all the preceding cases of antagonism to innovations of a like nature; indeed, it would be idle to conceal the fact, that Darwin already reckons amongst his disciples many scientific clergymen and ministers of the different religious denominations. The scriptural account of the creation of plants and animals presents as many difficulties one way as the other. The *literal* translation of Genesis i. 2, runs thus—"And God said, the earth shall sprout forth sprouts, herb yielding seed, fruit-tree yielding fruit after its kind, whose seed (is) in itself, upon the earth; and it was so." And of v. 20, thus—"And God said, the waters shall bring forth abundantly the prolific creation, a living soul, and fowl (that) may fly above the earth on the face of the expanse of heaven."*

Excepting for those who still believe in the doctrine that all plants and animals took their rise at one time, when the command was given, and were created in two days, we cannot conceive how this account can be held to convey any scientific exposition of the mode in which species were produced. We may be in error, but it does not appear to us to affirm more than the grand truth—that the Almighty created plants and animals, and that the former contained seeds "after their kind," or for their propagation; and (naturally enough when we consider to what class of minds it was addressed) it does not even hint at the mode in which animals were to be perpetuated. If, however, the reference to the earth and waters bringing forth plants and animals, presents any special evidence on the subject, it is rather in favour of their production through secondary agencies, than by a direct miraculous interposition for the purpose of making species. But suppose the account is meant to indicate (which, however, we do not for a moment believe) that all species were created as they stood or moved, by one grand miracle, how are we to explain the subsequent production of varieties by "nature" or by man? Those who hold the "orthodox" view must supplement it by an original doctrine of their own, and must believe that after having created species Himself by miraculous intervention, the Almighty must have deputed "Nature" and man to make varieties; or if (as we are fully convinced is the case) He has been as directly instrumental in the production of varieties as in that of species, what becomes of the miraculous creation of the former? As far, then, as the abstract theological bearing of the question is concerned, it becomes, as in most similar cases, a matter of individual opinion; but, on the other hand, it will be found presently, that if we were to admit the entire correctness of Darwin's theory, as expounded by himself, we should find ourselves involved in difficulties quite as grave and perplexing as those presented by the miraculous version, and we will now direct our attention more immediately to his teachings.

* Dr. A. Benisch's 'Translation of the Pentateuch.'

Before the publication of his views, the large majority of naturalists believed that "species" were distinct creations, chiefly on the ground that, when crossed, they are unable to produce fertile offspring; but that varieties which are fertile when crossed, are the modified descendants of species by generation. A considerable minority, who saw the difficulty of defining the limits of species and varieties, felt convinced that both are modified descendants of preceding species—in fact, that there has been a gradual progression from lower to higher forms of life, and that the terms "variety," "species," "genus," "family," &c., however convenient for classificatory purposes, are arbitrary designations invented by Man, and have no actual existence in Nature.

But then the question arose—how were these modifications brought about? It is true that many species were found to be very closely allied in their external characters through intermediate living varieties, or through fossil representatives; but the existence of those did not suffice to account for the change from one species to another, for it was a well-established fact that whilst there seemed to be hardly any limit to the production of fertile varieties, as soon as it was attempted to cross two species, either they refused to breed or they produced an infertile offspring. Many and ingenious were the theories of progression or transmutation propounded by various authors, either openly or anonymously, as in the case of the 'Vestiges of Creation;' but the doctrine which presented the most philosophical aspect was that of Lamarck, the celebrated French naturalist, who, about fifty or sixty years since, enunciated the theory that the different types of animals became modified during the ordinary succession of generations through the influence of their desires and wants, which compelled them to exercise certain organs and members in such a manner as to induce an extension, growth, or development of those organs in preponderance over others.* Lamarck also believed in an unknown law of progressive development. At first, his theory took naturalists by surprise, but it soon appeared to assume a somewhat ludicrous character, for it seemed absurd to suppose that by any such process of modification the neck of a deer-like animal should have been stretched to that of a giraffe, or the snout of a tapir into the trunk of an elephant; just as we find persons in the present day who laugh at Darwin's theory, as they cannot conceive it possible that some lovely companion, or intellectual savant, to whom they are showing a stuffed gorilla, should be the descendant, however remote, of so hideous an animal as stands before them. It must be remembered, however that since Lamarck published his views, many fossil types interme-

* The best reference on this subject will be found in Darwin's 'Historical Sketch of the Recent Progress of Opinion on the Origin of Species,' p. 13, 3rd edit.

diate between allied recent ones, have been found which, had they been known at that time, would, to a great extent, have removed these difficulties, and would probably have secured a larger share of popularity for his doctrine.

But what appears the strangest of all is that it has been the fashion of late with some of the disciples of Darwin, in their zeal for the establishment of his theory, to decry or under-estimate the value of Lamarck's doctrine. Not so with the illustrious naturalist himself, as any one may find, who refers to his introduction to the third edition of his 'Origin of Species;' and we think he has exhibited a sound judgment in giving full credit to the labours of his eminent predecessor. One of his most ardent admirers, however, Professor Huxley, told the working classes of London, shortly after Darwin's great work had appeared, that "when people tell them that Mr. Darwin's strongly-based hypothesis is nothing but a mere modification of Lamarck's, they would know what to think of their capacity for forming a judgment on the subject."*

Why the eminent physiologist in question should thus visit with his denunciations those who venture to differ from him on this interesting and obscure subject, we are at a loss to understand; but we cannot help admitting that we are guilty of this indiscretion. In several portions of Darwin's work, especially in his paragraphs on 'The Effects of Use and Disuse' (first edition, p. 134—third edition, p. 151), we cannot help seeing a resuscitation of Lamarck's doctrine; and as to his 'Law of Progressive Development,' it appears to us about the same as Darwin's 'Law of Variation;' and a more legitimate mode of expressing a mysterious influence than Professor Huxley's 'Tendency to Variation.' "The tendency to reproduce the original stock," says Mr. Huxley, "has, as it were, its limits; and side by side with it there is a tendency to vary in certain directions, as if there were two opposing powers working upon the organic being—one tending to take it in a straight line, the other tending to make it diverge from that straight line first to one side and then to another."† And again, "This tendency to variation is less marked in that mode of propagation which takes place asexually; it is in that mode that the minor characters of animal and vegetable structures are most completely preserved."‡

No one who reflects upon these observations, and the phenomena of conjugation, generally, can fail to be less strongly impressed with its mysterious influences than were Lamarck, Darwin, Professor Huxley, and others; and yet men either deny the constant operation of the Deity, or are seeking in the past for miracles to glorify him, whilst they fail to perceive them in the results of those generative processes with which they have become familiarized

* 'Lectures to the Working Men' (Hardwicke), p. 150.
† Ibid., p. 89. ‡ Ibid., p. 89.

through their every-day occurrence, and whose effect in the modification of species has never yet been properly considered.

Notwithstanding that the doctrine of "progressive development" was (and for that matter is still, by many thoughtless persons) branded as atheistical, and although it had been supported only by the imperfect observation of a few biologists, and the still more imperfect records of nature, it had been gaining ground rapidly for some time before Darwin ventured to revive it, endorsed by the results of an extensive experience, a long-continued course of study and reflection, and the honest convictions of a sincere lover of truth. Darwin was no apprentice in science when he gave publicity to his views. In the winter of 1831, when he had attained his twenty-second year, having been educated and taken his B.A. degree at Christ's College, Cambridge, he volunteered his gratuitous services as naturalist on board of H.M. surveying ship 'Beagle,' Captain Fitzroy, R.N., and made a voyage, or it would be more correct to say a continuous series of voyages, in that vessel to Bahia, thence to Rio Janeiro, Monte Video, Ports Desire, St. Julian, and Santa Cruz; the Falkland Islands, Terra del Fuego, Valparaiso, Chilöe, Lima, some of the islands of the South Pacific, New Zealand, Sydney, Van Dieman's Land, Mauritius, St. Helena, Bahia, Pernambuco, and back to England, where he arrived on the 2nd October, 1836, having been absent nearly five years, and making various exploring expeditions along the coast, in to the interior or to the islands adjacent to the ports where the 'Beagle' stopped. As ten thousand copies of the Journal of his researches during the lengthy voyage had been printed in 1860, we may safely infer that most of our readers are well acquainted with the contents of the volume, and few will be disposed to deny it the merit of being one of the most charming and attractive books of travel ever given to the world. But irrespective of its undoubted merit in this regard, and irrespective, too, of its value as a record of the scientific and social history of the lands and peoples visited by the illustrious naturalist, it now possesses a fresh value, inasmuch as its re-perusal, after the study of his book on the 'Origin of Species,' materially aids the inquirer in arriving at a correct estimate of the value of his new biological doctrine. Whilst we find in the 'Journal' that vast store of information which served as the starting-point for his further researches and the basis of many of his subsequent arguments, we cannot help being struck with the fact that his views must have undergone great modification between the time of his arrival in England in 1836 and the first publication of his great work on Species in 1859. When he wrote or published the 'Journal,' in 1845, he could hardly be regarded as a very staunch believer in the progressive theory; we are justified in coming to this conclusion by the opening remarks in his 'Origin of Species,' where he tells us

that during his voyage "certain facts in the distribution of the inhabitants of South America," &c., &c., "seemed to throw some light on the origin of species." Strangely enough, even as late as 1860, we find in his 'Journal of Researches'* the following expression concerning his predecessor: "Lamarck would have been delighted with this fact, had he known it, when speculating (probably with more truth than usual with him) on the gradually-acquired blindness of the aspalax—a gnawer, living underground, and of the proteus, a reptile living in dark caverns filled with water;" whilst in the introduction to his new edition of the 'Origin of Species,' published the following year, he speaks of Lamarck and his theory in such terms as would lead the general reader to suppose that he regards them with the highest admiration. Moreover, although the theories enunciated in his 'Origin of Species' are foreshadowed in his 'Journal,'† we cannot anywhere find a decided expression of opinion as to the origin of species by descent, although there seems to be a kind of vague idea pervading the whole work, that new species must have originated through some such process. This piece of evidence is of itself valuable to a student seeking to measure the mind of an author who propounds a doctrine widely at variance with popular views, for the published opinions of such a man, in fact, his whole *public* character necessarily guide the investigator in forming an estimate of his doctrines. Darwin's 'Journal' shows him to have possessed at that time traits which peculiarly adapted him to enter upon such an inquiry as he subsequently undertook. From his 'Journal,' he appeared naïve and truthful, thoroughly alive to the value and influence of religion,‡ a wonderfully close observer of every phenomenon, whether in natural history or social life and customs. His reasoning on the phenomena of nature—as, for example, with regard to the origin of coral reefs—is irresistible; he seems to weigh carefully everything that he or anyone else has observed before taking a single step in advance and to repeat his observations before he takes another. And through all his reasoning there appears to be no want of confidence in his readers. "Think for yourselves," he seems to say, "but I feel pretty confident my way of thinking will be yours." In fact, on reading his 'Journal,' one seems to travel with him; his graphic descriptions of men and countries, extreme and startling as they often are, never awaken a doubt, and he has no need of

* 'Journal of Researches into the Natural History and Geology of the Countries visited during the Voyage of H.M.S. "Beagle" round the World.' Tenth thousand. Murray, 1860. P. 52.

† See 'Journal of Researches,' 1860, pp. 131 and 132, 145 to 147, 173 to 176, 327, 377, *et seq.*; and especially as to the "struggle for existence," p. 435, beginning at line 1.

‡ Ibid., p. 300, beginning "With no particular zeal for religion," &c., p. 428, second and third par.; p 430, "Neither is the country itself attractive. I look back but to one bright spot, and that is Waimate, with its Christian inhabitants."

photographs beyond those of his pen, nor of any witnesses besides himself.

And there are certain phenomena connected with the nature of the lower animals and of man which appear at that time to have made a remarkable impression upon the young traveller. One of these was the "tendency to variation," by slow degrees, in some species. Speaking, for example, of a certain venomous snake in Patagonia, a Trigonocephalus, he says—

"Cuvier, in opposition to some other naturalists, makes this a subgenus of the rattlesnake, and intermediate between it and the viper. In confirmation of this opinion I observed a fact, which appears to me very curious and instructive, as showing how every character, even though it may be in some degree independent of structure, has a tendency to vary by slow degrees. The extremity of the tail of this snake is terminated by a point which is slightly enlarged, and as the animal glides along it constantly vibrates the last inch, and this part striking against the dry grass and brushwood produces a rattling noise, which can be distinctly heard at the distance of six feet. As often as the animal was irritated or surprised, its tail was shaken, and the vibrations were extremely rapid. Even as long as the body retained its irritability a tendency to this habitual movement was evident. This Trigonocephalus has, therefore, in some respects, the structure of a viper, with the habits of a rattlesnake; the noise, however, being produced by a simpler device."*

Another phenomenon, illustrating in a conspicuous manner his subsequent law concerning the preservation of favoured races and the extinction of others,—a most important feature in his theory of natural selection,—presented itself to his notice during his stay in Banda Oriental. It was connected with a peculiar breed of cattle in that country, and we will extract his account of it:—

"Don F. Muniz, of Luxan, has kindly collected for me all the information he could respecting this breed. From his account it seems that about eighty or ninety years ago they were rare, and kept as curiosities at Buenos Ayres. The breed is universally believed to have originated amongst the Indians southward of the Plata; and it was with them the commonest kind. Even to this day, those reared in the provinces near the Plata show their less civilized origin, in being fiercer than common cattle, and in the cow easily deserting her first calf if visited too often, or molested. It is a singular fact, that an almost similar structure to the abnormal one of the niata breed, characterizes, as I am informed by Dr. Falconer, that great extinct ruminant of India, the Sivatherium. The breed is very true, and a niata bull and cow invariably produce niata calves. A niata bull with a common cow, or the reverse cross, produces offsprings having an intermediate character, but with the niata characters strongly displayed. According to Señor Muniz, there is the clearest evidence, contrary to

* 'Journal of Researches,' pp. 96–7.

the common belief of agriculturists in analogous cases, that the niata cow when crossed with a common bull, transmits her peculiarities more strongly than the niata bull when crossed with a common cow. When the pasture is tolerably long, the niata cattle feed with the tongue and palate as well as common cattle: but during the great droughts, when so many animals perish, the niata breed is under a great disadvantage, and would be exterminated if not attended to; for the common cattle, like horses, are able just to keep alive, by browsing with their lips on twigs of trees and reeds; this the niatas cannot so well do, as their lips do not join, and hence they are found to perish before the common cattle. This strikes me as a good illustration of how little we are able to judge, from the ordinary habits of life, on what circumstances, occurring only at long intervals, the rarity or extinction of a species may be determined."*

We have extracted these two paragraphs at length, from his 'Journal,' to show that more than twenty-five years before the appearance of his great work on the 'Origin of Species,' Darwin's attention had been directed to, or, we should say, arrested by phenomena similar to those which he imported into that work in which we find no mention of either phenomenon although both would well have served to aid him in proving his theory; and we believe our zoological readers will agree with us that facts stated so unpremeditatedly are far more valuable than others selected by the author for the purpose of proving a point. Again, our readers will find, if they take the trouble to refer to his 'Journal,' that it contains much valuable information bearing upon the changes which have been effected in animals through migration, for throughout there are repeated evidences of variation in structure and habit being favoured by this cause.

One striking instance of this unconscious accumulation of evidence in favour of his subsequent convictions and, at the same time (if we rightly interpret his meaning), of his unbelief at that time in the transmutation theory, will be found in his account of the variation of species on either side of the Cordillera.† He shows that the species on the two opposite sides of this range are distinct but allied, although the climate, soil, and longitude and latitude may vary but little, and he attributes this variation to the barrier thus opposed to the migration of all but a few animals. In a note he says:—"This is merely an illustration of the admirable laws first laid down by Mr. Lyell, on the geographical distribution of animals as influenced by geological changes. The whole reasoning, of course, is founded on the assumption of the immutability of species, otherwise, the difference in the species in the two regions might be considered as superinduced during a length of time."

Of course, in his new doctrine, he does believe that the

* 'Journal of Researches,' pp. 146–7. † Ibid., pp. 326–7.

difference in species is superinduced "during a length of time;" and if we turn to his later work, we find that "neither the similarity nor dissimilarity of the inhabitants of various regions can be accounted for by their climatal and other physical conditions,"* but *that barriers of any kind*, or obstacles to free migration are related in a close and important manner to the differences between the productions of various regions.† He exemplifies this law by showing that whilst there is a very slow and gradual variation of species as one travels north and south on the continent of South America, the land barrier of the Andes causes us to find *abrupt* changes in species on the opposite sides of those mountains, though the actual longitudinal distance between the two regions may be small. Thus he seeks to prove that, in both cases, *time*, and not miracle, has been the cause of the change in species, either in permitting migration to regions with different physical conditions, or in raising a barrier which impeded migration and so left the inhabitants nearly but not immediately allied.

But if we find in the 'Journal of Researches' a very large store of information, which might have been successfully employed, had the author been so minded, in the establishment of his later theories, we cannot help being struck by the significant fact that there are many data which we should naturally have expected to find in his 'Origin of Species,' if his theory were founded on a sound and immutable basis. The young naturalist was not content to observe living plants and animals, rocks and fossils, but he directed a large share of his attention to men and manners, and had the opportunity so rarely afforded to naturalists of seeing, side by side, the very lowest and the highest types of mankind; and yet, to quote the words of one of his most enthusiastic and eminent disciples, "Mr. Darwin has said nothing about man in his book;" but, "if Mr. Darwin's views are sound, they apply as much to man as to the lower animals."‡

Now it is a circumstance which has more than once come under our own observation, that persons who have traded on the west coast of Africa, and have come into contact with the savages there (although the latter have, to some extent, enjoyed the advantages of European intercourse), have been almost irresistibly led to embrace Darwin's views, on the ground that the untutored beings whose habits they have been compelled to observe approximate so closely to the brutes. But the great naturalist has witnessed even more striking contrasts than they, and yet practically he is silent as to the origin of man.

* 'Origin of Species,' p. 376. † Ibid., p. 376.

‡ Professor Huxley: 'Lectures to Working Men.' It is, however, only fair to Darwin to add that this must not be taken literally, for he does say that he expects to see light thrown on the origin and history of man, should his theory be confirmed.—'Origin of Species,' 1st edition, p. 489, l. 3 and 4; 3rd edition, p. 523, l. 33, 34.

In Tierra del Fuego, he says he saw the most abject and miserable creatures he anywhere beheld.* On one occasion, all the men and women were naked, and the rain was pouring down upon them; on another, a woman, suckling an infant, "came alongside the vessel, and remained there, out of mere curiosity, while the sleet fell and thawed on her naked bosom, and on the skin of her naked baby." These poor creatures were "stunted in their growth, their hideous faces bedaubed with white paint, their skins filthy and greasy, their hair entangled, their voices discordant, and their gestures violent." Their wants and habits of life needed no faculties higher than those of an ape;† their capacity for improvement stood at zero; their language "scarcely deserves to be called articulate," and "certainly no European ever cleared his throat with so many hoarse, guttural, and clicking sounds:‡—

"One's mind hurries back over past centuries, and then asks, could our progenitors have been men like these? men whose very signs and expressions are less intelligible to us than those of the domesticated animals; men who do not possess the instinct of those animals,§ nor yet appear to boast of human reason, or at least of arts consequent on that reason, ... and part of the interest in beholding a savage is the same which would lead every one to desire to see the lion in his desert, the tiger tearing his prey in the jungle, or the rhinoceros wandering over the wild plains of Africa."‖

We are compelled to curtail this, and to omit many other passages of a like tenor, but have we not quoted enough to justify our surprise that, notwithstanding the revelations of bone-caves and of the drift, which prove that our progenitors have been "men like these,"¶ the ablest living exponent of the transmutation theory, and the founder of the doctrine of natural selection, should never so much as refer, directly or indirectly, to the origin of man?

Of course our readers are nearly all aware of the nature of that doctrine. His work on the 'Origin of Species' was published towards the end of the year 1859, about twenty years after the first appearance of his 'Journal of Researches,' the author having, in the interim, conferred great services upon the scientific world by his later treatises on the 'Voyage of the Beagle,' on 'The Structure and Distribution of Coral Reefs,' 'Geological Observations on Volcanic Islands,' 'Geological Observations on South America,' and other minor publications; indeed, he had already raised himself

* 'Journal of Researches,' p. 213. † Ibid., p. 216, par. 1.

‡ Ibid., pp. 205–6, last and first paragraphs.

§ He gives examples of unfeeling brutality towards their offspring of which animals are not capable.

‖ 'Journal of Researches,' p. 504.

¶ See, as a striking illustration of this truth, the remarks of Mr. Laing, M.P., in his work on the 'Pre-historic Remains of Caithness' (Williams & Norgate), especially at p. 56, where he compares the Caithness aborigines with the inhabitants of Terra del Fuego, as described by Darwin.

to the rank which he continues to hold, of one of the greatest naturalists the world has ever produced.

When Darwin's hypothesis concerning the origin of species is compared with that of Lamarck, that is to say, when we consider the evidence brought forward by our illustrious contemporary in support of his theory, as compared with the reasons adduced by the eminent French naturalist, who may be regarded as the original exponent of that theory,* we cannot help being astonished, first at the large amount of experience and information which had been accumulated by all classes of naturalists between the periods at which the two observers wrote; and, secondly, with the immense amount of original thought and observation that Darwin has brought to bear upon the question. This is most strikingly exhibited in the Introduction to the last edition of his work, where the author unintentionally groups around himself as writers in favour of his views, Lamarck, Geoffroy St. Hilaire, the Hon. and Rev. W. Herbert, Dean of Manchester, Prof. Grant, the Author of 'The Vestiges of Creation,' Prof. Owen(!), (he had not read the Introduction to Owen's 'Comparative Anatomy of the Vertebrata,' just published, or we think he might, perhaps, have omitted this celebrated palæontologist), Isidore St. Hilaire, Schaafhausen, the Rev. Baden Powell, Mr. Wallace, Prof. Huxley, Dr. Hooker, and others. We say "unintentionally" because he does not call them believers in *his* theory, but in that of the modification of species, of which he is the latest and most able exponent; and he might with propriety have added half-a-score of highly-respected and well-known naturalists (in the widest sense of the term), who, not unwisely, delayed the expression of their views until they should have had an opportunity of forming a clear and well-founded judgment upon his theory, and some of whom may be called his disciples, with a certain amount of reservation

He bases his opinion that living species are the modified descendants of other pre-existing species on various observed facts in nature. First, because it is possible to produce, and he has himself succeeded in producing, such a degree of variability in species under domestication as almost to amount to the creation of a new species, and he thinks that what he and others have been able to effect imperfectly, in a brief period of time, could easily be completely brought about by "Nature" in a practically indefinite period. Man, he says, does not actually himself produce variability, but this is accomplished by the conditions in which he places the creatures acted upon; and if they can produce it in one case (under domestication), they can in another (in nature). Let us inquire into the accuracy of these views as we proceed, and observe that whilst we are prepared to give him the full benefit of his *effects*, we

* Buffon had some vague ideas concerning the transmutation of species.

must demur to his construction of causes. It is true that man does not produce variability himself, in one sense, but he does so in another, and in the highest sense. Speaking of selection by man, the author says:—

"If selection consisted merely in separating some distinct variety and breeding from it, the principle would be so obvious as hardly to be worth notice; but its importance consists in the great effect produced by the accumulation in any direction, during successive generations, of differences absolutely inappreciable by an uneducated eye; differences which I, for one, have vainly attempted to appreciate. Not one man in a thousand has accuracy of eye and judgment sufficient to become an eminent breeder. If gifted with these qualities, and he studies his subject for years, and devotes his lifetime to it with indomitable perseverance, he will succeed, and may make great improvements: if he wants any of these qualities he will assuredly fail. Few would readily believe in the natural capacity and years of practice requisite to become even a skilful pigeon-fancier."*

If it necessitates such an amount of judgment, such indomitable perseverance, and so practised an eye to detect the slight differences needed for artificial selection, that even our illustrious experimenter and observer admits that he is unable to appreciate and avail himself of them, is it not at least a rational, or let us rather say a scientific inference, looking at the phenomena of Nature, that an Intelligence beyond our conception, but still acting in Nature as Man does in artificial breeding (for if it be otherwise, Darwin's theory falls to the ground), that such an omniscient Intelligence, we say, is ever and ever watching, directing, and employing each minutest change, producing cause and effect, co-adapting and co-arranging all things to perfection? But we shall have occasion to show hereafter that the author does not believe that the changes referred to are brought about "by means superior to, though analogous with, human reason," and if he has intended in some other manner to acknowledge his belief in an *ever-active* Providence, his volume has failed to convey such an impression.

And believing that "Natural Selection" is the agency in modifying species, the author considers that it acts by seizing upon, and transmitting it to its progeny, any slight differences which distinguish the individual from its parent, and which may be conducive to the welfare of that individual. In other words, if a change is taking place in external nature ("the conditions of existence"), and if a particular individual happen to possess an attribute, be it structural or instinctive, which better adapts it to that change, then "Natural Selection" marks that individual for its own purposes, just as man selects his ram or his ewe, his dog, his horse, or his pigeon, and the law which the author calls "the hereditary transmission of peculiarities" perpetuates the

* 'Origin of Species,' pp. 32-3.

distinctive and beneficial feature in the offspring, and a new variety is formed. The gradual accumulation of such differences, transmitted from generation to generation, at length forms, according to Darwin's view, a new species, then a new genus, a new "family," &c. The varieties, species, genera, or families not possessing these advantageous modifications, die out in "the struggle for existence," from their unfitness to cope with new natural obstacles, and to live under the changed conditions by which they are surrounded.

Now it will at once strike the reflecting reader, that before "Natural Selection" can lay hold of any divergences of character (physical or instinctive), those divergences must have made their appearance, and the inquiries naturally suggest themselves: How do these differences originate? And how does it happen that the new features have been of such a nature as to render their fortunate possessor better adapted for the conditions of existence? (Of course, we do not lose sight of the fact that changes injurious to the animal or plant may also present themselves, and these, the author tells us, are neglected or unheeded by "Natural Selection," which only seizes upon *advantageous* peculiarities, "favouring the good and rejecting the bad."*)

That there may be no misunderstanding, we will hear what the author himself says on the subject: 1. "Natural Selection" cannot *produce* any variation in structure or instinct;† and it can only act for the good of each being,‡ by the preservation and accumulation of inherited modifications, each profitable to the preserved being.§ It acts only by "very short and slow steps," and cannot produce any great or sudden modification.‖

Here we must stop to inquire: If no visible external influence can give rise to fresh variations in structure, what other natural or secondary cause *can* do so? The answer is, "sexual causes," or sexual phenomena; for such terms as "tendency to variation" or "laws of growth" do not indicate causes, but imply ignorance of them.

What, then, does the author tell us about sexual causes? With him it is "sexual selection," and he thinks, 2. That "a change in the conditions of life," by specially acting upon the reproductive system, *causes* or increases variability.¶ But is this not reasoning in a circle, or, worse still, is it not a direct contradiction of his own proposition, that "natural selection" cannot *produce* variability? We are not splitting hairs, nor cavilling about words, for he tells us distinctly in one place that natural selection "can act on every internal organ, on every shade of constitutional difference, on the whole machinery of life."** And again, in another place: "It

* 'Origin of Species,' p. 502, par. 2; and in many other parts of the work.
† Ibid., p. 107, par. 2, "Unless favourable," &c.; p. 84, par. 2; p. 103, par. 2.
‡ Ibid., p. 86, par. 2. § Ibid., p. 151, par. 1; and p. 492, par. 2.
‖ Ibid., p. 504, par. 2. ¶ Ibid., p. 86, par. 2. ** Ibid., p. 87, par. 2.

(Natural Selection) can modify the *egg, seed,* or young, as easily as the adult.* The more one reads and reflects, the more puzzled he becomes as to the powers attributed by the author to "Natural Selection." At one time it is "Nature," and is compared to Man,† that is to say, to Man's *mind*, for it acts intelligently. Again, the "Conditions of life" are not the same as Natural Selection, for "Indirectly, these" (the conditions of life) "seem to play an important part in affecting the reproductive system, and thus *inducing* variability; and Natural Selection will *then* accumulate all profitable variations, however slight, until they become plainly developed and appreciable to us.‡ Here it is "the Conditions of life," something distinct from "Natural Selection," that *begin* the work of modification; and yet, as we have been told, "Nature," or "Natural Selection," can itself act on every internal organ, on every shade of constitutional difference, on the seed, and on the egg; in fact, she, or it, *can* commence the work of variation as well as complete it. A very easy mode of solving the difficulty would be the omission of "Nature" (which, if it means anything, means the visible world), and the substitution of "an intelligent Deity," availing himself of His knowledge and power, and acting through His material world, to bring about all those changes to which the author refers.

But, unfortunately, we are precluded from substituting such an "hypothesis" on the authority of the author, for, as we have already stated, he tells us distinctly that he does not believe the more complex organs and instincts to have been perfected "by means superior to, though analogous with, human reason, but by the accumulation of innumerable slight variations, each good for the individual possessor." §

Is not this the same as though he were to tell us that he does not believe the perfected steam engine to be the product of human intelligence, but the gradual accumulation of slight improvements in and additions to its various parts?

But let us set aside for the present the cause, and by that we mean the active, intelligent agency, which is always modifying living beings, whether that agency be the Almighty in nature, or man by art; and let us confine ourselves to the simple propositions that all beings are and have been the modified descendants of pre-existing ones, and that if we were fully acquainted with the biological history of the globe, we could trace all living races of plants and animals back through their ancestry to the "few forms or one" into which Darwin believes "the Creator originally breathed life with its several powers;"‖ and also that the conditions of life in

* 'Origin of Species,' p. 144, par. 2.
† Ibid., p. 87.
‡ Ibid., p. 151, par. 1.
§ Ibid., p. 492, par. 2.
‖ Ibid., p. 525.

which the various living tribes have been placed, were such as favoured, or conduced to the calling forth, popularly speaking, of new powers and instincts. Thus limiting our inquiry, we find in his great book a mass of evidence almost sufficient to establish the hypothesis of Lamarck, and quite enough to justify naturalists in assuming that new species have so arisen, until some still more amplified rule is presented to them. Neither can we deny their right to adopt Darwin's theory as their guide in classification, as the nearest approach that has yet been made to a scientific method of explaining the leading biological phenomena of nature.

One great objection that has been raised against his mode of accounting for the origin of species is, that he has not himself been successful in breeding a new variety, which, when crossed with others from the same parent stock, produced a sterile offspring; in short, that he himself has been unable to make a new species. This fact has, we think, been unfairly weighed and treated both by the eminent investigator and his opponents. The former seeks to prove that intertility is not the infallible rule with crossed species in nature; and he takes great pains to make light, as it were, of the phenomenon as an objection to his theory. If he had succeeded in this better than he has done, he would simply have shown his unprejudiced readers that the exceptions prove the rule; but it would, as it appears to us, have lent additional strength to his cause if he had fully admitted this well-established law of nature. For it is quite natural and completely in agreement with the view that the Almighty slowly changes the instincts and structures of living beings in accordance with the changing surface of the globe, that those instincts and structures should, by becoming more and more divergent, cease to render the possessors attractive to and conformable with each other. This plain mode of regarding the question causes the presence of a new species to assume quite a fresh significance; and this aspect of the case appears to us well worthy of consideration. The controlling influences of external nature, although analogous to hybridism,* may not be sufficiently rapid in their operation to serve as a check upon the production of new beings, and therefore it would appear that Providence has applied hybridity as a special check,† a kind of ratchet, as it were, upon the revolving wheel of life; and thus appears to be prevented that reversion to the original stock which might otherwise take place through uncontrolled inter-crossing, and also a too rapid production of individuals on the surface of the globe. The appearance of a new species is, according to this view, to be considered as the result of an impeditive or conservative influence, rather than one of the progressive phenomena in nature.

* See 'Origin of Species,' p. 299, last paragraph.

† In this Darwin does not believe. See ibid., p. 299, par. 2.

As to the opponents of the theory, their readiness to employ the author's inability to create a new species, has rarely been the result of honest scepticism, for they have rather sought to show what he has *not* been able to effect, than ready to estimate the value of what he *has* accomplished. Upon his line of argument, however, there can be little doubt that hybridism becomes a much graver objection to the theory of transmutation, than if we consider it as a special check applied by Providence (probably in the process of fertilization) and in the manner and for the purposes specified; and this is another weak point in an otherwise well-founded theory.

The most striking data in favour of descent with modification, and those which are likely to be multiplied from year to year, relate to the geographical distribution of plants and animals, and to their paleontological history. We have already touched upon some of the facts observed by Darwin before he was a believer in his own doctrine, whilst still on his travels; and if our readers wish to study the subject fully, we would refer them more especially to his account of the Galapagos Islands,* and of the geographical distribution of American animals,† and would recommend a comparison of these his earlier researches with the chapter in his 'Origin of Species' upon geographical distribution. But here, it will be more useful if we bring before our readers an example of the mode in which the theory is silently working its way amongst those naturalists who are directing their attention to this phase of the subject.

In Numbers II. and IV. of this Journal (April and October, 1864), there appeared two papers, one by Dr. Sclater, a general zoologist, "On the Mammals of Madagascar;" another by Mr. Trimen, of Cape Town, a lepidopterist, on the Butterflies of the same island. Of the experience and abilities of these, our contributors, it would be superfluous, perhaps unbecoming, on our part, to make any comment. From the two papers, it would appear, that while the mammals of Madagascar are almost entirely peculiar to that island, having but slight affinities with those of Africa and the East Indies (chiefly with the latter), the butterflies of the same island are almost the same as those of the nearest mainland, Africa. Dr. Sclater seeks to explain the peculiarities of the Mascarene fauna, 1st, by assuming the truth of the theory of the "Derivative Origin of Species;" and 2nd, by supposing that anterior to the existence of Africa in its present shape, a large continent, which he proposes to call "Lemuria," occupied parts of the Atlantic and Indian Ocean; that this continent "was broken up into islands, of which some became amalgamated with the present continent of Africa, and some, probably, with what is now Asia," and that in Madagascar and the

* 'Journal of Researches,' p. 393. † Ibid., pp. 131 and 326.

Mascarene Islands we have existing relics of this great continent, which he regards as "the original focus" of the Lemuridæ, the characteristic Mascarene group of animals.

But Mr. Trimen could not see the necessity for the creation of this vast continent, so promptly conjured up and baptised by Dr. Sclater, finding, as he did, in Madagascar, "eighty-one species of diurnal Lepidoptera, of which forty-seven are known to be natives of Africa, while the great majority of the remaining species exhibit unmistakeable affinity to African forms." Had such a continent existed as that believed in by Dr. Sclater, "how is it," he asked, "that the same divergence of species has not taken place between Mascarene and African insects (which are numerous in individuals and rapid in succession of generations), as we find between Mascarene and African mammals?" In concluding his article, Mr. Trimen just hints at the possibility of butterflies flying or being wafted across a barrier impassable for mammals!

Now, as these curious phenomena present a direct bearing upon our inquiry, we have been seeking as much information as possible upon the past history of the localities referred to; that is to say, upon the paleontology of the east coast of Africa and the west coast of Madagascar, hoping that that would throw some light on the subject; but to our regret, we find that nothing is known of either. In the course of our inquiries, however, we received a note from one of those whom Darwin may justly reckon amongst the "young and rising men" of science, to whom he looks for the complete establishment of his theory, from Mr. H. M. Jenkins, the Assistant Secretary of the Geological Society, and this correspondent demolished Dr. Sclater's continent of "Lemuria" almost as unceremoniously as it had been brought into existence, and substituted the "infinitely more likely hypothesis," based upon known laws of paleontology, that "a connection had doubtless existed between Africa and Madagascar at some more or less remote tertiary period," but that "the tide of emigration or chain of affinity (between the Mascarene mammals and those of other continents) passed through Europe, *southwards* into Asia, Africa and America, in Eocene or Miocene times."* We are not aware whether Dr. Sclater considers himself a disciple of Darwin, as does our correspondent last referred to; nor can we observe in the facts before us that either reasons strictly upon the Darwinian hypothesis, for according to the views of the great naturalist, there should be a nearer affinity between the mammals of Madagascar and those of Africa, which is separated from the island by a narrow ocean channel, than between the former and the mammals of India, which is much further removed, whilst the contrary appears to be the case; but one thing

* Of course we are authorized by our correspondent to publish his views.

is quite clear, namely, that however much these naturalists may differ from one another, two out of three agree with Darwin as to the "derivative origin of species;" and as it appears to us, the third (Mr. Trimen) unconsciously adds another link to the strong chain of evidence in favour of his theory presented by the geographical distribution of animals.*

But the plain facts of paleontology, as well as its empirical laws, tell forcibly in favour of a slow and gradual modification of species. Before Darwin's views on the subject were published, Vogt, a well-known German systematizer, had already interlinked into his graphic account of recent forms, the fossil species which serve in some degree to bridge over the structural gaps that occur amongst the former; and from every portion of the world, as the soundings of its crust are taken, we receive fresh accounts of missing links in the chain of beings. One grave difficulty in the way of the acceptance of the new theory, which would have sufficed to daunt many an ardent investigator, has of late been partially removed. Darwin, of course, does not believe in the miraculous creation of new species, and expresses his surprise at the credulity of those authors who imagine "that at innumerable periods in the earth's history, certain elemental atoms have been commanded suddenly to flash into living tissues;"† but when he asks himself, "How far do I extend the doctrine of the modification of species?"‡ he is, or rather was, necessarily unable to give anything like a satisfactory reply; for when he sought to trace the origin of life in the rocks, he was arrested apparently at the extremes of the palæozoic strata by fossil forms, lowly, indeed, as compared with the vertebrates, but still far higher than many that now swim our seas and streams, and it was just as difficult to explain how these were created without ancestors of a still more primitive type, as it would be to account for the Origin of Man under similar conditions. Scarcely, however, had the first sounds of the violent controversy which followed the publication of his work died away, when the intelligence reached us from Canada, that in the primitive rocks there, which had been deemed void of life, the remains of a type resembling one of the lowliest living organisms had been discovered, and naturalists, in their accustomed haste to generalize, have termed it Eozoon—the first or earliest living being. Darwin frequently refers to the imperfection of the geological record, and although it is hardly probable that we shall ever have a perfect record whilst a large portion of our globe is covered with water, still we recognize in the discovery of the humble type alluded to, an augury that a

* *Vide* 'Origin of Species,' p. 416, beginning "Sir Charles Lyell;" and p. 427, par. 2, as to the whole question between Dr. Sclater, Mr. Trimen, and Mr. Jenkins.

† Ibid., p. 517, l. 19, 20.

‡ Ibid., p. 518, l. 4.

sufficiently extensive collection of data will be presented to us to enable us—or we should rather say, to enable posterity—to form an accurate judgment as to the order and succession of living beings in ancient times and their relations to living species.

So far, these data are all in favour of the theory of the origin of species through modified descent; and a few would-be orthodox naturalists, who seek to explain the facts of palæontology otherwise, prefer to trump up absurd and, as it appears to us, irreverent theories of their own, rather than to accept the simple truth as it has pleased the wise Creator to engrave it upon his enduring tablets of stone.

The investigation of the origin of life on the globe hardly comes within the limits of this inquiry, and Darwin scarcely mentions it. At present it is still very obscure, and many generations may pass away before we are enlightened with regard to the mode in which living beings originate—possibly that may be an inscrutable problem for ever—but a far more relevant and striking feature in our inquiry is the origin of Man himself. There seems to have been an impression amongst naturalists, including many of the most able, that if the doctrine of transmutation be correct, man must necessarily be a direct descendant from some ape; but why this should be, it is difficult to understand. If any unprejudiced inquirer will take before him the table that illustrates Darwin's book,* and with that for his guide, will carefully consider all the leading facts which have of late been so largely debated in connection with Man and the Simiæ, we venture to think that he will not be disposed to admit the necessity of Man's ape-origin, be he ever so firm a believer in Darwin's theory; but, on the contrary, that he will regard it as more probable, that whilst the highest ape stands at the head of one succession of types, about to become extinct, Man is at present placed at the highest pinnacle of another; though it is highly probable, looking at his present condition and his faculty for improvement, that his past lineage is brief when compared with its future extension.

There are many obscure points connected with the 'Origin of Species,' on which it may be said that we have expressed ourselves with uncertainty, but there is one, respecting which we desire to be very explicit. We have no sympathy with the aversion manifested by some men towards the development theory on the ground of feeling. It was doubtless as offensive to the dignity of our forefathers, when they were told that they were not the denizens of a world around which the universe revolved, as it is to some persons in the present day to hear that we cannot "go with the angels" here, as long as our animal nature adheres to us. But will anyone maintain that the earth has lost any of its dignity, or is less noble,

* 'Origin of Species,' p. 123.

because it revolves around a luminary from which it has derived its being (physically speaking), but which is probably of a lower cosmical nature than it is; and should it in like manner be shown (as will probably be the case) that our animal frame is derived by the usual generative succession "from some lower stock" of animal, will anyone hereafter venture to say that man is less noble on that account?

But certain well-ascertained facts appear to militate strongly against the assumption that man is descended in a direct line from the apes. 1. Although very degraded types of mankind exist amongst us to-day, and traces of similar beings have been discovered in the later geological formations, it is admitted that no form has yet been revealed, which serves as the approach to an intermediate link. The most impetuous followers of Darwin are the most positive on this point. 2. Although we find at the present day savages almost as untutored and undomesticated as any *animal* "Man," of which we can form a conception—indeed, in some cases almost below the highest domesticated animal in their mental character—and although these beings must have existed through untold ages, often exposed to every state of the weather in absolute nakedness, there has been no reliable case of a tribe reverting to the hairy type, nor any trace of such a variety of the human race having existed as aborigines in former times. And 3. Whilst the intelligence of the apes cannot be said to have advanced in proportion to the complexity of their organization, but to have reached its climax before we approach those forms nearest to Man; the intelligence of Man appears to be of a different nature to that of the apes, which are even less capable of sympathizing with man than some of the domestic quadrupeds; and this intelligence, *sui generis*, appears just to have entered upon the dawn of its development, and to present an unlimited future.

But whilst the problems of the origin of living beings and of Man present no serious obstacles to a belief in the simple doctrine of the transmutation of species, they do offer fatal objections to Darwin's version of that theory. If his law of natural selection is valid in one case of animal progress, it must hold good in all, and he has no more right to pass over the consideration of "the first steps in the advancement, or in the differentiation or specialization of parts," in "looking at the dawn of life"* (in the lowest types of animals) as an inscrutable problem, than he would have to select any other phenomenon difficult of reconciliation with his law. And then what has he to say concerning the origin of the sexes themselves? It is true, he tells us that "he is strongly inclined to suspect that the most frequent cause of variability may be attributed to the male and female reproductive elements having been *affected* prior to the act of conception;"† but we would appeal to readers

* 'Origin of Species,' p. 137. † Ibid., p. 8.

of every shade of opinion, whether this is not what the illustrious naturalist himself so often calls, when he refers to the theories of his opponents, a restatement of facts. And where was the necessity for the very existence of the sexual elements at all? What "law" of nature created these? We know that many of the lowest types of animals can and do multiply rapidly and effectively by fission (subdivision of their bodies) and gemmation (budding); and we know, too, not the least so from the wonderful array of facts collected by this most untiring observer, that the pivot upon which the whole question of animal progress turns, is just this one of sexual peculiarities! From the very commencement of life up to the present hour, there are evidences of an *immediate* designing power—or, to use a term which is looked upon with disfavour by many Darwinians, an *ordaining* Power; an occult influence in the production and modification of the sexual elements, and consequently of the beings springing from them, totally distinct from the "conditions of existence," "natural selection," or whatever else the force may be called, which influences the embryo and the born creature. How often is it that the deceased *father* is resembled by his posthumous offspring? Had it been the mother, this might be explained by the conditions of gestation; but to what is it to be attributed in the case of the father? Is there anything in Darwin's law—is there not something beyond "atavism," or "the hereditary transmission" of peculiarities (phrases themselves implying ignorance, not knowledge, of natural laws and operations), which causes this constantly-recurring miracle connected with the conception of living creatures?

But the facts of embryology afford very striking evidence in favour of the origin of species by modified descent, and undoubtedly the surrounding conditions of existence have great influence upon the growth of the embryo. The resemblances between the fœtal stages of the individuals of different species, too, lend additional probability to the same doctrine; but whoever has the smallest acquaintance with Comparative Embryology must know that whatever value its facts may present in enabling us to judge the question under consideration, they apply equally to Man and to the lower animals.

It is not surprising that when Darwin comes to treat of instincts, he should find in their study but little in favour of his theory of Natural Selection. Still he believes that the latter has the power "of accumulating slight modifications of instinct to any extent in any direction;"* and judging by analogy, that is, when we compare this with similar language relating to the modification of the structure of animals, we should be justified in inferring that he believes natural selection to be capable of framing the minds of animals. On

* 'Origin of Species,' p. 229, par. 3; p. 265, par. 2.

the other hand, we can hardly believe that he assumes so much for his favourite theory, for elsewhere he says, "I do not pretend that the facts given in this chapter strengthen in any great degree my theory, but none of the cases of difficulty to the best of my judgment annihilate it." * That visible nature, in some cases, limits and retards, in others stimulates the physical as well as the bodily activity of living beings, no one will deny, and that such an influence is as applicable to Man as to the lower animals, is just as obvious; but that nature has been, or is, a power, in the well-understood acceptation of the term, acting upon the mind of animals, or of man, or anything but an unconscious agent, very few will admit, and we can hardly believe that the illustrious naturalist himself holds such a creed.

Sometimes, indeed, the "conditions of existence" are all-powerful in evoking the nobler qualities of animals and men. For Man these "conditions" may be a forest glade, a range of towering peaks, a well-stocked library, a few tuneful sentences; any of these may fan the latent spark of genius, which has lain smouldering for years, and cause the flame to burst forth suddenly. But there are cases where, notwithstanding that the "conditions of existence" may have a repressive tendency, the "instincts"—or in Man the soul—will assert its supremacy, and will mock all Darwin's laws and theories. See, for example, the ungainly peasant, who, under the law of the "hereditary transmission of peculiarities," should have pared his turnips, chewed his bacon, and guided his plough, as did his ancestors before him—how he, encircled by the same "conditions of existence" as surrounded them, spurns their grovelling pursuits, dives down into the depths of physical truth and brings up some pearl of inestimable price, which his "highly educated" fellow-men have in vain been seeking on the surface; or soars upwards to the sky, and descends again with other truths, less pleasing to the sense, perhaps, but serving as another link in the bright golden chain uniting Earth and Heaven.

In this review of some of Darwin's labours, we have been led into many digressions, for which the eminent author is to some extent responsible, for a more suggestive series of works than his has rarely been published; and this we conceive to be one of their most valuable elements. The objection to his theory of "natural selection"—and it is a grave one for the reason already assigned—is, that he refers all the perfect operations of Nature to an imperfect law. Then we may be asked, Why should such a law be regarded? Simply, because it is the best extant. Why, we would ask, is society ruled by imperfect laws? Why is honesty in trade, to a large extent, maintained by clumsy and defective mercantile codes?

* 'Origin of Species,' p. 265, par. 2.

Because it pleases God to give scope for the exercise of the human intellect by reserving a portion of the truth for man to search out, and thus stimulating each successive generation to reform itself.

As far as we are able to judge, after many years' careful and unprejudiced observation, Darwin is right as to effect, and as to cause, he is partially so. In other words, the Ruler of the universe does use the means so beautifully described by him to bring about certain phenomena in nature, but He appears to employ other and still unexplained means as well. Until, however, some naturalist, possessed of larger powers of observation and comparison, and of a courage equal to that of Darwin, shall arise to complete the theory of "natural selection," or, what will more probably be the case, shall substitute a more perfect theory just as this one is more complete than that of Lamarck; until then, we say, "Darwin's law" will continue to guide naturalists of every order in their biological inferences and zoological classifications.

But we cannot help expressing our surprise that so able and observant an inquirer as Darwin can fail to see in the wonderful array of facts collected in his great work, "one long argument" in favour of a constant, ever-watchful, ever-designing, and ever-active Providence. He can perceive the immediate intervention of that Providence in the "original inbreathing of life" "into a few lowly forms, or one," and yet (limiting ourselves strictly to the boundaries defined by him) in the instinct of the bee, which deftly builds its nest, or unconsciously fertilizes the insensient orchid;* in the remarkable powers of climbing plants, which possess the faculty of moving in conformity with the requirements of plant-life, † and equally in the affectionate intelligence of the domestic animals, he can see only the action of "secondary causes," and fails to perceive in all these and a thousand other phenomena of nature and of mind, the *continuous* application of an Almighty Power acting with design. Have too close reasoning and observation drawn a veil across the scene so long admired and watched by our great naturalist, or what has caused this curious obscuration?

This is the great defect pervading Darwin's work; but it is not the weakness of an imbecile, nor yet the foible of an obstinate dogmatist; it is, we hope, the unconscious and, let us trust it soon will be the conscious demerit of a great work, undertaken and partly accomplished by one of the noblest, most exalted, and most brilliant intellects of our age.

* 'On the Various Contrivances by which Orchids are Fertilized by Insects,' (Murray, 1862), p. 2.

† 'On the Movements and Habits of Climbing Plants' (Taylor & Francis, 1865), p. 118.

II. CONSIDERATIONS ON THE LOSS OF THE 'LONDON.'

By William Fairbairn, C.E., F.R.S., &c.

The introduction of iron as a material in constructive art has been attended with great advantages. For the purposes of ship-building it has given greatly increased strength, and afforded facilities for obtaining new forms, which, aided by the power of steam, have ensured a rate of speed in vessels never before attained in naval history. It has, moreover, furnished the naval architect with a material of immense value as regards construction, and its careful distribution in the shape of ribs, frames, and the sheathing of vessels cannot be too highly appreciated. As compared with the best English oak, it exhibits four times its powers of resistance, and it has in addition the double advantage of being almost perfectly homogeneous and free from the defects of open joints, which in the case of the planking of wooden vessels require to be caulked. With all these advantages, iron constructions are surrounded with many dangers when entrusted to the care and superintendence of incompetent persons; in such hands there invariably exists a want of proportion in the formation of iron vessels, which exhibit defective powers of resistance, and such other abnormal conditions as might prove destructive to the efficiency and ultimate security of the structure. It is therefore necessary that the naval architect or builder should be conversant with the properties of the material employed, whether considered separately or in combination, and moreover, he should be satisfied that the vessel, when finished, is capable of permanently resisting the forces of tension and compression, and all the varied strains to which she is subjected when afloat.

In laying down the lines of a ship, all these conditions should be carefully and deliberately considered. It is also of importance to take into account the forms or lines of least resistance, such as a fine entrance at the bows, and an equally clear run at the stern, if high speed is the object to be attained. In such cases, these forms are highly advantageous for vessels navigating rivers and smooth water, but in those intended for long sea voyages, and having to contend with the waves of the Atlantic or the rolling seas of the Cape, it is questionable whether or not some slight sacrifices should be made to speed, and some modification effected in the form of the bows and stern, in order to meet all the requirements of a safe and convenient vessel intended for the double purpose of carrying passengers and cargo.

I have been led to these particular considerations, not so much from the lamentable accident which overtook the 'London,' as from the conviction, that the safety and success of a vessel does not depend so much on its speed as upon its sea-going properties and sound con-

struction. If, for example, we take one of the present iron clippers—which make such quick voyages—with her sharp bows and fine proportions, I am of opinion that she is neither the safest nor the best description of vessel to contend with a heavy sea in foul weather. In the first place, she is a *diver*, which cuts into the sea and rises with difficulty from a *bath*, which covers her decks with water as she pitches from sea to sea. But these are not the only objections to vessels of this form, as repeated immersions of this kind are exceedingly uncomfortable to those on board, and cause the ship to lift some tons of water before her buoyancy is restored to meet the next and every other succeeding wave into which she plunges in a rolling sea. It is not my intention from these observations to depreciate the value of speed either in the Royal or Mercantile navy. On the contrary, I think it is the duty of every ship-builder to approximate as closely as possible to the lines of least resistance, which, in my opinion, ought to be carried to its utmost limits in smooth water, but in smooth water only.

In the construction of vessels of war, it was found expedient to rectify this want of displacement at the bows by projecting the submerged portion of the hull forward in the shape of a ram, not so much, however, for the purpose of attack, as to give buoyancy to the ship, and to enable her to rise more lively upon the sea. These defects of construction were observed in the iron-plated frigates 'Warrior' and 'Black Prince,' the former vessel pitched and rolled heavily in the Bay of Biscay from similar causes, which from the first have been observable in all our high-speed ships. Viewing the subject in this light, it may not be out of place to suggest that all passenger and emigrant ships should be modified in their construction, so as to give increased displacement at the bows and stern, but more particularly at the bows, where they require buoyancy, having to encounter the force of a large body of water rushing over them and scouring the decks from stem to stern. Many of us remember the bluff round bows of vessels of the last century, and how they rolled and pitched in a gale of wind. They were, however, short and compact, and although deficient in speed, they were nevertheless dry and excellent vessels at sea.

For several years I have endeavoured to impress upon the minds of naval architects and others, the necessity of increased strength on the upper decks of sea-going vessels, in order to balance the forces of tension and compression, and the double bottoms on the cellular principle of construction. The ultimate strength of a vessel is the resistance of its weakest part, and this being the case, it is evident that it is of little or no value to have a strong double-bottom if the deck is liable to be torn asunder by the alternate strains of a vessel pitching at sea. That these strains, often repeated, lead to fracture does not admit of doubt, and it has

been proved by experiment, that under these circumstances time is the only element in the endurance of the structure, and this varies according to the intensity with which the strains are produced. I offer these remarks from the conviction that heretofore the decks have been the weakest parts, and that several iron vessels have broken right in two from the constant working of alternate strains at midships along the line of the decks. I have also, by way of illustration, compared an iron ship to a hollow girder, supported at each end and resting on the middle for the exclusive purpose of showing the alternate changes to which she may be subjected if stranded or placed in the dangerous position of rising and falling on rocks in a heavy sea. Exceptions may be taken to these views, but they nevertheless exemplify what is necessary to be observed in the construction of a strong ship, and I may probably be excused the comparison, when the object in view is to effect security in the construction of our iron vessels.

I have been confirmed in my opinions on the forms and strain of vessels, from such facts as I was able to gather from the narrative of the loss of the ship 'London.' From the accounts and the different statements of the witnesses examined before the Commissioners appointed by the Board of Trade, I was unable to discover any serious defect in the construction of the ship. On the contrary, I have reason to believe that both material and workmanship were perfectly sound, with the exception of the combings of the hatches, which it would appear were imperfectly secured. As respects the design, I have assumed that she inherited the extremely fine lines at the bow and stern already described, and to which I have directed attention, and additional weight is given to this opinion by the manner in which the vessel behaved at sea. Taking all the circumstances into account, as also the statements of the different witnesses, with regard to the rigging and the state of the decks, I arrive at the conclusion that the ship did not founder from any serious defect of construction, excepting only the insecurity of the hatches, but from the hurried manner in which vessels are sent to sea, with their decks crowded with coal, hampers, and a variety of articles always dangerous and always objectionable in long and narrow vessels that are low in the water and liable to ship every succeeding sea. If these matters and the upper rigging had been properly cared for, there would have been no broken jibboom to batter to pieces the combing of the hatchway, and instead of the 'London' being entombed with all on board at the bottom of the Atlantic, she would, by this time, have been well advanced on her voyage to Australia.

III. SEWAGE AND SEWERAGE.

1. *First Report from the Select Committee (Dr. Brady's) on the Sewage of Towns, together with the Minutes of Evidence and Appendix.* Ordered by the House of Commons to be printed, April 10, 1862.
2. *Second Report from the same Committee.* Ordered by the House of Commons to be printed, July 29, 1862.
3. *Report from the Select Committee (Lord Robert Montagu's) on Sewage (Metropolis), together with the Proceedings of the Committee, Minutes of Evidence, Appendix, and Index.* Ordered by the House of Commons to be printed, July 14, 1864.
4. *Third Report and Appendices of the Commission appointed to inquire into the best Mode of Distributing the Sewage of Towns and applying it to beneficial and profitable Uses.* Presented to both Houses of Parliament by command of Her Majesty. 1865.
5. *The Present State of the Town Sewage Question.* By Gilbert W. Child, M.D., of Exeter College, and Physician to the Radcliffe Infirmary, Oxford. Oxford and London: John Henry and James Parker. 1865.
6. *General Report of the Commission appointed for Improving the Sanitary Condition of Barracks and Hospitals.* Presented to both Houses of Parliament by command of Her Majesty. 1861.
7. *A Manual of Practical Hygiene, prepared especially for Use in the Medical Service of the Army.* By Edmund A. Parkes, M.D., F.R.S. London: John Churchill & Sons, New Burlington Street. 1864.
8. *The Sanitary Management and Utilization of Sewage.* By William Menzies, Deputy Surveyor of Windsor Forest and Parks. London: Longman & Co. 1865.
9. *National Health and Wealth.* By the Rev. H. Moule. 1861. (Pamphlet.)
10. *Memoir on the Cholera at Oxford in the Year* 1854, *with Considerations suggested by the Epidemic.* By Henry Wentworth Acland, M.D., F.R.S., &c. London: John Churchill, New Burlington Street; and J. H. & J. Parker, 377, Strand. Oxford: J. H. & J. Parker. 1856.
11. *Seventh Report of the Medical Officer of the Privy Council, with Appendix.* 1864.

The problems of Sanitarian Science seem sufficiently complex; but the most pressing and primary of them will run in the simple formula: How are we to dispose of our Sewage without either spoiling our rivers, or robbing our fields, or poisoning ourselves?

This particular question may seem uninteresting or even repulsive, but the events of the last few years, and more especially of the very last, have given it a claim on the immediate and close attention of every man who has at heart his own well-being and that of his fellows. It seems also at present far removed from a speedy and definite settlement; but men of science and men of practice rarely work together without compassing their common object; and the conspiracy of modern chemists and engineers with modern agriculturists and sanitarians will assuredly form no exception to the rule.

In this article we purpose, first, to delineate in the merest outline and from the practical as well as from the scientific point of view, the question, as it should be presented to a person, who, living in one of our many needlessly unhealthy towns, has his attention necessarily focussed by what he daily feels and sees and reads upon the subjects more or less systematically treated in the long list of works hereto prefixed. And in the second place, we shall point out the special merits and particular claims of each of those works, hoping thereby to place our readers fairly on a level with the present somewhat extensive literature of this department of hygienics.

We take it of course for granted that all who read these lines are convinced of the immediate bearing which the purification of our houses, streets, and streams has upon both the moral and the economical interests of the nation. Market Drayton, indeed, a town belonging exactly to neither of the two counties of Shropshire and Staffordshire, but an equal discredit to both, did last autumn get up a riot in the interests of filth, and rejected the Local Self-government Act, emulating therein, and not unsuccessfully, the conduct of those men of the "most brute and beastly shire" of Henry VIII.'s realm, who sang of old in defiance of a similar movement for their own improvement,—

> "Let us be men,
> And we'll enjoy our Holland fen."

There is, however, no reason to think that many other towns can be found to follow the example; Market Drayton is, so far as we know, a unique instance of such a condition of things in the nineteenth century; and its exhibition of folly and brutishness is probably to be referred to some temporary excellence in the organization of the class which has a direct interest of its own in keeping the low lodging and public-houses, as well as other centres of moral and physical debasement, undisturbed and uninspected. Pure air, indeed, and pure water reduce greatly the need and the desire for stimulants, and the temptation thence accruing to the poor man to betake himself to the gin-palace, so that the gentry we allude to were, in a scientific point of view, wiser in their generation than probably they were aware of. The words, "Thou shalt eat but not

be satisfied," precede the words from the Prophet Micah, quoted by Dr. Hunter in his now famous Report,* "And thy casting down shall be in the midst of thee." But as Mr. Simon, to whose good office we owe the Report just alluded to, promises another shortly, which shall show us what such towns as Worksop and Salisbury have really gained by cleansing and keeping themselves clean, we will say no more now and here of the value, urgency, and importance of Sanitarian Reform, but proceed to the details of Sewers and Sewerage.

We may do well to begin by passing in review the different methods which have been proposed and adopted for dealing with sewage whilst within the precincts of our towns, and indeed, of our very houses. All modern and most ancient plans for dealing with sewage refuse aim or aimed more or less directly at its destruction or removal. The Jews used the agency of fire† in the valley of Hinnom, for the purification of their city; and while in the Wilderness they used earth‡ outside their camp as their disinfecting agent. The Chinese and the Japanese have a system for removal of sewage in substance, either without the admixture of other matter, or as compost, but without mixing any special deodorant with it. Agrippa did for the Romans, in the time of Augustus, what Mr. Bazalgette has done for the Londoners in the time of Queen Victoria, and the rush and volume of his main drains has been commemorated by Pliny, and earned the title of "*torrens cloaca*" from Juvenal.

Side by side with these and other systems for the removal of excreta there has existed from time to time a system for its non-removal,—and to it we will now devote a few lines. It might have been hoped that this system was definitely numbered with the things of the past, but we are informed that even in these days it has its adherents, much as Paganism, which it resembles in the matter of foulness, retained and regained occasionally a few votaries long after the acceptance by the civilized world of a purer form of faith.

Mr. Rawlinson declares that though some of the rivers in Lancashire are indescribably foul—so foul, in fact, that birds can walk over them in places—they are less injurious to health than are the cesspools with which the towns in that county are so richly honeycombed.§ A delicate nostril, we are told, can detect the peculiar odour of these abominations in many a well-furnished house in continental cities, in spite of the fumes, whether of tobacco or other

* 'Seventh Report of the Medical Officer of the Privy Council, 1864.' Appendix, p. 256. Micah vi. 14.

† Bazalgette on the Main Drainage of London. 'Proceedings, Institution Civil Engineers,' vol. xxiv., 1864–5, p. 3.

‡ Deuteronomy xxiii. 12, 13.

§ 'Evidence before Lord Robert Montagu's Committee on Sewage (Metropolis),' p. 147 (3,997), p. 186 (4,219), p. 177 (4,058).

more refined perfumes, the empyreumatic and therefore more or less antiseptic properties of which may account for their all but universal employment in such countries. It is, in most cases, a mere mockery to speak of the "hermetical closure" and sealing up of a cesspool; for its liquid contents penetrate almost inevitably into the neighbouring wells, spreading and multiplying cholera and typhoid fever, whensoever these plagues arise among us, in a manner the most unmistakeable. And the air we breathe is tainted by the cesspool even more surely than the water we drink. Such structures are, in fact, gasogenes of the very foulest kind; and even when they are not placed directly beneath a house, as of old, the draught exercised by the fires in the houses they are connected with, and the specific lightness of the gases themselves, make their access to every room a certainty, in the default of an all but impossible system of trapping and ventilation. The condition of Chichester, as given in a recent Privy Council Office Report, and as contrasted with the condition of Salisbury, is, perhaps, a crucial instance of the effects of the cesspool system of non-removal of sewage. Mr. Menzies, Professor Way, Mr. Henry Austin, Mr. Rawlinson, and the Barrack Improvement Commissioners, all alike denounce the system unsparingly in the different books placed at the head of this article; and a certain Sanitary Commission, called the Metropolitan Commission of Sewers, abolished in the year 1847–1848 no less than thirty thousand of these centres for pollution,* in what is now the healthiest capital in Europe. But though science and practice are both alike so opposed to its being, the cesspool has yet its proper place and right to existence. In the case of houses in the country, with land about them in large quantity—measured, that is, by the pole and perch, and not by the square yard or foot, not built upon, nor to be built upon—a cesspool constructed so as to be as nearly watertight as possible, fitted with ventilating tubes and trapped, may be entirely innocuous, and by the addition of purifying apparatus made highly profitable. Indeed, even in a town, a person who possesses a large garden may, by placing his cesspool at the most distant part of such garden, contrive that it be, if not wholly uninjurious to his neighbours, at all events, nearly so to himself.

Of the various plans for removal of sewage, the simplest is that which merely takes it away without the addition to it of any water or the admixture with it of any disinfectant or deodorant substance. It has or might have its place and application in regions where from extreme drought or extreme cold, water is not available for the same purpose, and where labour is cheap. In a populous town and a civilized country the watertight carts which would be necessary for carrying out such a system would be so numerous as to block up† the streets, and whilst thus rivalling all other modifications

* Bazalgette, *l. c.* p. 6.

† Rawlinson: 'Evidence, Lord Robert Montagu's Committee,' p. 184 (4,177).

of the "dry method" in cumberousness and expense, it exceeds them all considerably in offensiveness. Mr. Menzies, however, shall describe its demerits for us:—"There is no doubt," he says at page 6, "that this affords the least complicated means of utilizing the sewage; but the whole tendency of the people in this kingdom is towards cleanliness, and they will readily sacrifice what is apparently useful if anything so disagreeable as this is forced upon them. This system is carried out thoroughly in China and Japan; but its advocates admit that Europeans endure a martyrdom of smells in these countries, while they forget that a vast amount of human labour in these two countries is the cheapest form of transport, while in Europe it is the dearest; also that in Britain nothing is more studied or better understood than engineering and mechanical arrangements which involve the least outlay of either skilled or unskilled labour. Neither do the towns in China and Japan yield, like those in this country, vast quantities of horse manure, which is much more easily managed, and which by its abundance in the neighbourhood of large towns in England diminishes the agricultural value of sewage. Nor could this system of iron pans be adapted to dwelling-houses."

On the other hand, it is right to say that Sir Joseph Paxton, though, as a horticultural physiologist, he was fully aware that "plants could not take up solid manure in its crude form, the spongioles becoming ulcerated by contact with it, and that therefore an application in a diluted form was the application by which plants were best supplied," did, in his evidence given before Dr. Brady's committee (see Second Report, p. 17, 2,511), hint that mechanical science might one day make a removal in this way very possible, "without our ever knowing anything about it or having the slightest possible smell in the house." "In the diluted form," he proceeds to say, "it is very valuable, but in the solid form it would be commercially much more valuable." The plan is employed in certain barracks in Germany and also at Glasgow.* The Japanese and Chinese are ordinarily taken as illustrations of the success which may attend the adoption of this plan; and we are far from thinking that we may not learn many valuable lessons from nations whose vast experience and urgent necessities must have forced upon them so many lessons of ingenuity and economy. The Rev. Mr. Moule, indeed, of whom we shall have to speak again,† has recommended for adoption in English cottage architecture a plan of utilizing the heat of the fire in hollow house walls, the principle of which has for centuries been acted on by Chinese builders; but in this matter of the utilizing of sewage, we are inclined to think that the difference of our social conditions

* See 'Report Barrack Improvement Commission,' p. 91, and figure in illustration.

† 'Gardeners' Chronicle,' June 18, 1864.

renders their example inapplicable to us. It is their habit* to dilute their manure very largely, even though not so largely as to the extent of the forty gallons of water per head of London extravagance, before they apply it to the land.

The poudrette of the Patent Eureka Company, on the other hand, is sown broadcast over the land in a dry form,† a plan which we think contrasts to disadvantage with these Oriental methods, and which must ultimately impair somewhat the success which, we learn, has been considerable in the town of Hyde. Even the Chinese, as we gather from Mr. White's evidence,‡ put on record in the Blue Book last quoted, "have the idea that manure, whether the production of bipeds or quadrupeds, if applied to land in a dry state, burns the plant." Of the carriage of the material whence this poudrette is manufactured, from the places where it is produced to that where it is operated upon by the Company, nothing need be said beyond what we have already hinted at, as to the encumbrance and annoyance which a crowd of "collecting carts" would create in our streets. Of the process of manufacturing it, we read nothing unfavourable in the evidence given (*l. c.*) by the chairman of the Company.

Of the different plans for the removal of refuse by the agency and with the assistance of one of the three "elements" of the ancients—earth, to wit, water, and fire, the last is, from a purely chemical point of view, the best, as being the most thoroughgoing. It is organic compounds, containing either nitrogen, or sulphur, or phosphorus, or all three of these substances, which form the most deleterious products of sewage; and the state of perfect oxidation into which burning brings them, even if it does not confer any infinitesimal disinfecting power upon their *disjecta membra*, renders them wholly innocuous as miasms. This method of destroying refuse has again and again been recommended and employed in epidemics, with the best results; and it has been recently recommended by the Cattle Plague Commissioners. But in happier and ordinary times it will be, we hope, inapplicable in practice, though so perfect in theory—such worship of Moloch would be intolerable in a country where furnaces have been occasionally, and steamboats not rarely, compelled to consume their own smoke. We leave the subject, therefore, with the remarks that the partisans of the "Cinereal" theory of manures would do well to show their faith by establishing such works for dealing with refuse as the Jews had in the Valley of Hinnom. When they have done this, then, but not till then, will Mr. Lawes be held to have had the worst of the argument, and the German substitution of "nitrogenous" and "non-nitrogenous manures," for "organic" and "inorganic manures," be believed

* Liebig's 'Natural Laws of Husbandry,' p. 393. Dr. Brady, 'Second Report,' p. 71.
† Dr. Brady's Select Committee, 'Second Report,' p. 21 (2,600).
‡ Ibid., p. 6 (2,335).

to give a full and true account of the points really at issue between Rothampstead and Munich.

The "earth-closet" system, as advocated by the Rev. H. Moule, of Dorchester, is scientifically well-nigh as thoroughgoing as the system of purification by fire. It is even less amenable to objection on the score of offensiveness; but we fear that considerations of expense, as well as the mechanical ones of difficult conveyance and transport, will restrict the sphere of its application to certain public institutions, and render its adoption impossible, at least to any great extent, in private dwelling-houses.

The ordinary Englishman has an extraordinary horror of domiciliary visitations, and especially does he abhor them when they are of the kind which this system postulates. The economist knows that suspension in water is a cheaper, as the least economical of men knows it is a less offensive, mode of carriage than any modification or adaptation of the scavenger's cart. And, finally, the agricultural chemist thinks, indeed, that earth is the true medium for the deodorization and the utilization of sewage, but he thinks also that the true way of acting upon this conviction is to bring the sewage to the soil in the irrigated meadow, not the soil to the sewage in the earth-closet. But we should not be doing justice to our convictions, if we did not recommend Mr. Moule's pamphlet most strongly to the attention of our readers, and express our belief that this system, though not so universally applicable in this country as the system of removal by water, may yet—under certain circumstances, and especially under such conditions as attach to public institutions—be found of easy application and permanent usefulness.*

Of the plan which would substitute ashes and ashpits for earth and earth-closets, we must speak in very different terms. The advocates of that system should assuredly be sent to Coventry to learn what its working really is. The mayor of that town we find giving evidence to the following effect before Dr. Brady's Select Committee (see 'Second Report,' p. 85, 4,497). Mr. F. Wiley: "In all new houses, we will not sanction a plan unless they build a water-closet, because we consider the wet ash-pits which are used so injurious to health. As a medical man, I really have seen so much evil from those nasty ash-pits in a yard half-full of sewage, that no poor people ought to be allowed to live near them." 4498. Mr. Caird: "Not if they are nasty?"—"They are all nasty; not a private house can drain them, and the corporation will not allow you to drain an ash-pit into the sewers; these ash-pits generate fevers in the neighbourhood; I believe the nasty ash-pits in towns are the greatest source of fever; they poison your water and they poison

* We cannot speak from personal knowledge, but we understand that Messrs. White & Co., of Bedford Street, Strand, London, have made arrangements for demonstrating the mode of operation of Mr. Moule's invention in all its different forms.

your air." This is to the point. And we may add that, according to a paragraph in the 'Times,' of November 16, 1865, the ash-pits of Manchester take their fitting place, amongst some half-dozen barbarous abominations, as causes of a recent severe outbreak of fever in that unwholesomely managed city.

The water-closet system for the removal of excreta comes lastly for consideration—a system which, though of recent date, and, out of this country at least, of comparatively limited development, is yet in a fair way towards establishing itself ineradicably in the domestic arrangements of the upper classes of civilized nations. Its economical merits rest on the engineering axiom, "Carriage by suspension in water is the cheapest mode of transport;" and its merits on the score of inoffensiveness need no other exposition than a certain country will furnish, in which the water-closet is even now something of a novelty, and known even yet by the name of "*Cabinet Anglais.*" Its demerits are—first, in an agriculturist's eyes, the exceeding dilution to which it subjects manurial matters at all times, and most especially at times when the country is already saturated with rainfall; and, secondly, from the sanitarian's stand-point, the great liability to derangement under which it labours at times of severe frost in wealthy, and at all times, in poorer houses. Of the agricultural difficulty, Mr. Menzies offers one solution, and to this subject we shall recur, addressing ourselves in the meanwhile to the Hygienic aspect of the system. And it must be confessed that here, as elsewhere, the old proverb holds good, "*Corruptio optimi pessima.*" All-efficient, innocuous, and inoffensive as is the in-doors water-closet if properly fitted up, it may be made as noisome as, and assuredly will be more noxious than, the old-fashioned out-door retreats, if it be not so fitted up. The precautions to be taken relate, first, to the lighting and ventilation of the room itself; secondly, to the ventilation and trapping of its outlet-pipes; and, thirdly, to the communications which these discharge-pipes are allowed to set up with other waste-pipes. These precautions we will give in the words used by Mr. Rawlinson in his paper of 'Instructions and Suggestions to Local Surveyors with respect to Main Sewers, Drains, and Waterworks.' "House-drains," says Mr. Rawlinson, "sink-pipes, and soil-pipes, should have means of external ventilation. Down-spouts may be used for ventilation, care being taken that the head of such spout is not near a window. Inlets to all pipe-drains should be properly protected. Water-closets, if fixed within houses and having no means of direct daylight and external air ventilation, are liable to become nuisances, and may be injurious to health. Water-closets should have a daylight window, not a 'borrowed light,' and fixed means of ventilation which can neither be seen nor tampered with. Permanent openings, equal to a slit twelve inches in length and one inch wide, should be provided."

If these rules and regulations are disobeyed, the house of the

richest man in the country may be made, as we know such houses have not rarely been made, as fertile of fever as the most wretched of our town or even of our village alleys. Defective "house-work" of this kind, at Croydon, has been shown by Dr A. Carpenter* to have been the true cause of such unhealthiness as has recently prevailed there; and the carelessness of the owners of house-property, as to carrying on their private works in a safe manner and upon correct scientific principles, has thus cast an undeserved doubt on the general results of the Croydon sanitarian works, which the gentleman just quoted says, have been "eminently successful," whilst those of the irrigation have been "marvellously so." And just as the rich man can make his private house poisonous, so the lodging-house keeper, by the like means can, and often does, make the atmosphere of his hired apartments as depressing and even dangerous to the health of the jaded holiday-maker, as the confined air of his chambers or office had become. The indoors arrangements, or rather misarrangements, of a house situated in the most salubrious of localities may neutralize all the advantages of outer nature, and the weary man may find that he is, at the end of his month's vacation, as poor in health as he was at its beginning—*magnas inter opes inops.*

If the water-closet system is fraught with such dangers to those who, *ex hypothesi*, have the power of taking care of themselves, it may seem to be rash to recommend its introduction among the lower grades of society. But, just as we should recommend the retention (which, indeed, needs no such recommendation) of this system amongst the upper classes, but should imperatively urge the adoption in all cases of the precautions above specified, so, for the poorer part of our population, we believe that the water-closet system, at all events under that particular modification of the ordinary arrangement known as the "Latrine," is, after all, the best also. For full details and figures of the different forms of latrine, we refer to the excellent 'Report of the Commission for the Improvement of Barracks and Hospitals,' at p. 87; but the general statement of the relative merits of the latrine and the water-closet which the Commissioners give we will herewith quote:—"Water latrines," they say, "are preferable to soil-pans," *i.e.* water-closets, "because they are not open to the same objections. They can be made to consume a very small amount of water; they cannot be injured by any ordinary force; they are simple in construction, require very little repair, and are easily kept clean. There are various forms of these latrines in use, but the principle of construction is the same in all. It consists in placing a water-trough under the seating, which is filled to a certain depth with water, and

* 'Times,' December 19, 1865, and the 'Croydon Chronicle,' January 20, 1866; and a pamphlet by Dr. Westall, 'On the Advantages to be derived from the Adoption of the Local Government Act as exemplified at Croydon.' Ridgways, London, 1865.

discharged into the sewer or drain once a day at least. The whole process is simple and efficient, is attended with very little nuisance, and is perfectly innocuous to health. The different forms of latrine vary in construction and in adaptation to their object." The introduction of this modification of the water-closet system into our over-crowded alleys would be a boon indeed; and its machinery, in all its varieties, is, or can be made, so simple that it is less liable to derangement, and consequent pestiferousness, than almost any other structure intended for the same purposes.*

Mr. W. Bridges Adams, indeed, is wellnigh, if not quite, the only engineer of note now living who would demur to Mr. Bazalgette's dictum that "the rapid and continuous removal of town refuse by water is the best and cheapest mode of cleansing populous towns and cities," and who would consequently disapprove alike of water-closet and latrine. In a letter which recently appeared in the 'Times,' Mr. Bridges Adams writes thus:—"Those who have thought deeply on the subject, and thoroughly recognize the utility of the labours of Mr. Bazalgette, as applied to the present time, do not believe that water in rivers, or elsewhere, was intended by Providence to be a carrier of filth for all time. They believe that a noxious substance like the exuviæ of plants or animals is rendered more noxious by being mixed with water, and that until it can be buried underground for the purposes of manure, it is better to keep it as dry as possible, and that the transit will thus be rendered cheaper and less wasteful. When the time shall come for this perception to be common, the chemical and mechanical practicability will not be lacking, and we shall be no longer under the necessity of resorting to water gravitation to help our laziness, in polluting every channel in the land which has a downward slope into the sea." On the other hand, besides the Mayor of Coventry and the enormous majority of professional engineers, we have Mr. Rawlinson speaking unreservedly in favour of the water-closet system, and saying what it is interesting to know with reference to the introduction of this system among the poor, that it is possible to have a town, such as Alnwick, so "completely water-closeted," that "the very beggars' common lodging-houses have water-closets or soil-pans."†

The laws which govern the flow of fluids in pipes and in open channels have attained that mathematical precision and accuracy which renders discussion of them uninteresting and superfluous. Full details as to the size, and shape, and fall of sewers, and the quantity and velocity of their contents may be found in a paper by Mr. Bazalgette, already referred to ('Proc. Inst. Civil

* See Dr. Williamson: 'Edinburgh Monthly Medical Journal,' Feb., 1866, p. 699. "One means of cleanliness should be employed by the poor in common with the rich, and that is, the existence of water-closets in their houses." Dr. Williamson is well acquainted with the poor, being one of the oldest parochial surgeons in Scotland.

† Evidence before Lord Robert Montagu's Committee, p 186 (4,216).

Engineers,' vol. xxiv. Session 1864–1865), and also in Dr. Parkes's 'Practical Hygiene,' p. 306, and we pass *per saltum*, therefore, from the consideration of sewage at its source and in its place of production, to the consideration of its ultimate disposal and destination, remarking, in so passing, that sewers and main drains need ventilation as much as sink pipes and house drains; and that though tall chimneys, such as those of furnaces and factories as now employed at Woolwich, or other tall vertical tubes, as recently, at Malta, may help in doing this, it is better to reduce the need for it within the narrowest limits, by securing that rapid and constant flow of water through the sewers which will prevent the generation of foul gases within them.

Entering now upon the debateable ground of the disposal of sewage, we shall keep before our eyes the aphorism, "*Citius emergit veritas ex errore quam ex confusione*;" and feeling ourselves that the dogmatism of one man calls forth the research of another, and so is ultimately profitable to both of them and to others, we beg, at the same time, our readers to consider that if we make categorical statements, we do not impose them as articles of faith, to be required of any man to be believed, but propound them merely and shortly as results to which investigation of the subject has brought us, and may bring them or may not. As it seems to us, then, upon the evidence before us, any town-corporation which could command an acre or so of the lightest and poorest land for the reception in open grips and by gravitation of the sewage of from every fifty to every hundred of its inhabitants, might safely count upon a handsome return, in reduction of their local rates, from the sale of the grass crops they would thus and there raise. But it appears that all these conditions must be present if a pecuniary profit is to be secured, besides and beyond the great negative saving which all such disposal of sewage effects, in the way of prevention of disease. When guano has become scarcer, and the farmer more enlightened, it will be otherwise; but, in the meanwhile, it is easy to see that, in many cases, no adequate supply of land may be cheaply available, or that such as may be so, and may also have the sandy or loamy constitution which fits it for irrigatory purposes, may yet be situated so as to stand in need of an expensive lifting and pumping apparatus; or, finally, that the only available area may be an impermeable clay, and thus be physically unfit for the duties which its chemical character would excellently qualify it for. The observation of the great comparative purity of the water which flows out of the thick felt which the American weed forms now in so many of our ditches and sluggish streams, has suggested to us that, in such unfortunate cases as those we have just specified, arrangements might be made for sending the sewage of towns through a network of ditches filled with this

vegetable filter. The growing vegetation, besides setting free into the foul water an abundance of purifying oxygen, would build up into its own substance a quantity of valuable manurial salts, which would make it worth the farmer's while to dredge it up and plough it into his land. The positive return from such a harvest as this would be small indeed as compared with that of the Italian or other grass from the meadow, which, in such cases, is unattainable *ex hypothesi*. Still, such a plan, if not positively profitable, would at least be negatively so, by destroying the mischievous and morbific properties of the sewage it dealt with; and thus, as, with the exception of vice, nothing is so expensive as disease, it would effect a real economy. We believe that if a sufficient amount of ditch network were employed, the water which would flow out from the further outlet of the maze would be wellnigh as clear and pure as that which has received the orthodox amount of filtration through four feet of soil, prescribed and followed at Croydon. The account recently given to the world by the Metropolitan Main Drainage Committee, of the application of the irrigation system to this place and of its results, we herewith append.

"After Rugby, your Committee visited Croydon, where they found the application of the sewage carried out with far greater completeness. The land treated is immediately adjoining Boddington Park, and consists of 250 acres of loamy soil, running into sand and resting on the chalk. There is a gentle inclination of the service of the whole towards the Wandle, very favourable to the operation to be performed. The sewage is coarsely filtered, and carried by gravitation through an open cut to the edge of the farm; from this cut it is distributed by small grips or drains, and made to overflow by extemporized sluices inserted here and there by the labourers. The population whose excreta flows over this land is about 17,000 in number, from which 3,000 tons per acre per annum are said to be derived; one-tenth of the land is under irrigation at a time, and each acre is under treatment thirty-six days in the year. The sewage takes about five hours in flowing over the land from the time of leaving the inlet; that period is sufficient entirely to deodorize it, and to enable the herbage to abstract from it the fertilizing salts; after the process has been continued two or three days, it flows off nearly tasteless, colourless, and inodorous. The greater portion of the farm is sown with Italian rye-grass, which requires resowing every three years, and appears to produce the largest results; but some parts are still in natural pasture. It is rented by the Croydon Local Board at 4*l*. per acre, and is sub-let to Mr. Marriage at 5*l*. per acre, so that the Local Board obtain an improved rent of 250*l*. per annum, which goes in reduction of their local rates. Your Committee could not ascertain the exact weight of grass produced. It is cut four times a year, and each cutting

sells for about 8*l.* per acre; it is used chiefly for stall-feeding dairy cows. The expense of laying out the surface for irrigation was stated to be from 6*l.* to 10*l.* per acre, of which the Local Board paid 4*l.*; the cost of the rough filtration is nearly defrayed by the sale of the deposit, which fetches about 1*s.* 6*d.* per load."

To this we may add that the success of Croydon has been rivalled at Carlisle and Edinburgh; and that in all three of these cases, the soil on to which the sewage has been discharged has been a more or less light loam, or even, as at Craigentinny, barren sand;* and, finally, that from none of these places has any evidence as yet been gathered as to the applicability of sewage to root or grain crops. The history or rather the natural history of Croydon furnishes a curious proof of the thoroughness of the purifying to which sewage is subjected by irrigation. At p. 51 of the Report just quoted we read:—"Before the present arrangements were in force, the Croydon board had to meet numerous law-suits, on account of the pollution of the river by the sewage; but so efficiently is the sewage now purified, that those having the right of fishing in the river have found it worth while to fix gratings to prevent the fish going up the main outfall from the sewage irrigated land." We believe, however, that, though putrid sewage is poisonous under all circumstances, alike to man and beast, perfectly fresh sewage is, even when wholly unfiltered, far from being destructive of fish and of other (especially invertebrate) forms of aquatic life. The pike haunted the mouths of Agrippa's main drains; and a bold explorer may readily satisfy himself of the identity in this respect of the habits of modern English and of ancient Roman fish. Fish thus fed were considered in the time of Juvenal, and may be considered also in ours, as exceedingly proper food for the parasites or hangers-on or henchmen of the rich man; but fat and well-liking though such fish are, we should be sorry to see them set before any other class of the community. They pick out, it is true, from the solid matter of sewage, fragments and particles which would otherwise have to undergo a long series of dismemberments into simpler and simpler compounds, till some kindly vegetable should deign to re-compound them, and they build up these débris at once into their own substance, but this substance or flesh of theirs, we submit, can scarcely seem attractive when its history is considered, and we believe besides that persons who, being superior to prejudices, will venture upon it, will find other than sentimental reasons for abjuring its use.

It is the solids of sewage which, though containing perhaps but a sixth or a seventh part of its valuable elements, make it so difficult to deal with. They cannot be allowed to spread or smear themselves over the vegetable growths, to which either as grass in the

* 'Third Report,' Appendix, p. 199.

meadow or as weeds in the ditch we trust for disinfection, since, besides being thus unsightly and unsavoury to man, they would be injurious and indeed fatal to the plants and their functions. And to pipes and pumping they are as obnoxious as they are to living beings. Filters consequently of one kind or another, either coarse ones of wicker-work, or more complex combinations of sand, gravel, and ashes, alternating with strata of hurdle-work, are employed to free sewage from these troublesome constituents. Of the coarser kind little need be said, beyond suggesting, that a rapid flow of the main drainage contents over an artificially roughened bottom might by the attrition and contrition of the matters referred to, set free at once into solution, or at all events into suspension, much that might otherwise remain for a long time clogging the filtering hurdles and being otherwise offensive and noxious. The more complex kinds are well described and figured both by the Barrack Commissioners ('Report,' p. 86), and by Mr. Menzies (p. 23); and from the latter gentleman we learn the interesting fact, that we owe the suggestion of the principle of upward filtration to the ingenuity and insight of the late Prince Consort. Filters, whether simple or complex, are liable to displacement and derangement by the sudden influx of storm-water, as well as to clogging by any sudden afflux of the solids of sewage; and on these grounds filters, together with filtering beds, should always be provided in duplicate, side by side, as in the figure given by the Barrack Commissioners.

Much of the labour which we should otherwise have had to impose upon ourselves and our readers, in estimating the merits and claims of the several works, the titles of which stand at the head of this article, has been saved to us by the judicious and well-written pamphlet of Dr. Child. The title of his pamphlet is modest, and we can assure all persons who may wish to gain a knowledge of this subject and its literature, on the easy terms of reading an agreeably written tract, that they will find the performance to exceed by much the promise of the title-page.

As it is the fashion in England—a country where the Government makes its presence to be seen and felt in no other ways than by the penny post and the policemen in our streets and areæ—to depreciate and vilipend all else that wears the Government stamp, we ourselves, having, and indeed desiring, no other relation with the Government than that which the former of the two functionaries just specified sets up between us, think it right to set ourselves against the prevailing fashion, and to say something in praise of the much and most unjustly abused Blue Books. We are glad to observe that Dr. Parkes (p. 266 *l. c.*) makes no secret of the extent of his obligations to the Barrack Commissioners of 1861; and, being well able to stand upon his own merits is not niggard in his bestowal of praise on others. In days, however,

like these, when praise is not always rightly bestowed, when Dr. Croly writes two octavo volumes of apology for George IV., when Lord Wrottesley would fain reverse Sir Walter Scott's judgment on Dr. Paris's *philisterhaft* 'Biography of Sir Humphry Davy,' and speaks of it in his address to the Royal Society as "a most felicitous instance of a perfect biography," and M. About gives to the world, with his own name appended, a glorification of Prince Jerome Napoleon, we cannot recommend any one to take any panegyric on trust, and we recommend our readers to obtain this same Report* and read it for themselves. It is with a feeling of shame that we recollect that in an English House of Commons objections were raised to the payment of some small salary to one of the authors of this Report, much as, we doubt not, in many a garrison town objections were raised to the carrying out of its recommendations, which have saved and will save to the country hundreds of lives and thousands on thousands of pounds.

Of Dr. Parkes's work on 'Practical Hygiene' we can speak in the very terms which he applies to the Barrack Commissioners' Report, and say that "it is difficult to speak too highly of its excellence." It treats of many subjects besides those treated of by the Commissioners or glanced at in this review; but in all alike, its information, style, and spirit are of the very first order of merit. Biological and hygienic science is advancing rapidly, but it will be long before Dr. Parkes's book is superseded.

Dr. Acland's 'Memoir on the Cholera in Oxford' may serve as a model for the drawing-up the histories of similar visitations. It is marked by the grace and insight of its accomplished author; and giving a picture of the disease at once in its social, its medical, and its statistical aspects, it will furnish every reader with the information which his taste, knowledge, or ignorance may lead him to seek for.

The 'Seventh Report of the Medical Officer of the Privy Council' is a production of great value; but, like Dr. Parkes's book in this particular also, it travels over several topics—that of vaccination, for instance, with which we have no concern here. By a short but excellent Report of Dr. Hunter's, 'On the Alleged Injury from the Sewage Works at Northampton,' in which we find the *vera causa* of the mischief to be, as at Croydon, defective house arrangements, and here, notably, our old enemy, the cesspools, we pass from the hygienics of the entire community to those of the poor exclu-

* This, we should add, from our own experience, is no easy task; the wise regulations of a certain Chancellor of the Exchequer (not the present one) having, we are told, curtailed greatly the number of Blue Books issued and distributed, and expedited greatly their passage into the hands of the waste-paper seller. The taxation, however, of this great country has been relieved by this measure to the extent of several pounds sterling per annum in postage.

sively, as expounded in Dr. Hunter's longer Report contained in the same volume, and already referred to in this review.

We have spent so much time and occupied so much space with what concerns alike rich and poor, whom, Anthropology notwithstanding, we believe to be of the same species, that we cannot here and now dwell, as we could wish, upon the anti-sanitary condition of Lazarus. If the limits of our islands could be expanded consentaneously with the increase of our population, the profession of the political economist and the occupation of the statesman would both alike be gone. But so long as our territory remains inextensile, whilst our people continue to be fruitful and over-replenish it, so long do we remain liable to hear any day the cry of the Hebrew prophet, "Thou has multiplied the people, but not increased the joy," rising into tones articulate and loud enough to alarm the most thoughtless. Whispers and echoes of this cry can be caught at all times by the attentive ear in over-crowded England; the years that are coming upon us may make its notes familiar to all of us. Those who are best acquainted with all the multiform shapes of poverty's degradation, are agreed that physical amelioration must take precedence of all less material improvements; and finding that vice is as surely linked on to filth, in their experience, as cleanliness is bound up with godliness in the proverb, they would agree with us in thinking that the line of reform about which we have here been writing should be entered upon first of all.

The agricultural economist, however, as well as the sanitarian, is concerned in the questions of sewage and sewerage; and whilst the latter will find the works already passed in review to be drawn up more particularly from his own point of view, those which still remain to be noticed, deal mainly, though not exclusively, with the engineering and financial aspect of the matter. The 'Third Report,' indeed, 'of the Commission appointed to inquire into the best Mode of Distributing the Sewage of Towns,' contains almost equal amounts of the discussions, interesting to either class of investigators. Mr. Rawlinson, in a paper occupying some eight pages, divides his most valuable advice pretty impartially between the two classes of claimants for information and direction; whilst a long memorandum on 'The Contamination of the Water of Leith,' by Dr. Stevenson MacAdam, is, as we should expect, more specially sanitarian. The description Dr. MacAdam gives, at p. 36, of the intimate relations which prevail in Scotland in "the non-drainage localities"—*i.e.*, "in the smaller towns and villages,"—between the cesspools and the wells cannot fail to be interesting, and, indeed, something more than interesting, to the tourist who contemplates visiting that romantic but somewhat uncleanly country. The names of Lord Essex, Mr. Lawes, and Professor Way (the two latter of whom, by the way, pledge themselves, at p. 80, to 5,000 tons of sewage as being the

proper annual quantity for properly selected grass land) guarantee the value of the bulk of this octavo, which treats of matters more purely agricultural and economical. It should be added, that no one can be held to have thoroughly mastered this subject who has not read the two Reports preceding the one which we have just noticed, as well as the two others, drawn up by Dr. Brady's Committee, which preceded the one to which we are now about to draw the attention of our readers.

This last and largest of our Blue Books, the 'Report, with Appendices, of Lord Robert Montagu's Committee,' is a vast volume, such as might have been presented to both Houses of the Brobdignagian Parliament by the order of the king of that realm. Partly owing to the demand which existed for this Report, and partly, we imagine, owing to the wise regulations for the "happy despatch" of Blue Books, to which we have already alluded in a note, this gigantic Blue Book is not, we apprehend, procurable by ordinary mortals. The Report (under which word we have elsewhere in this article, for brevity's sake, included Report and Appendices) itself is but short; and its salient points are easily reproducible, but that the evidence given, and the applications and tenders made, to the Commissioners and the Board of Works, in every style and by men of every class—from men decorated with the Victoria Cross down to men who accuse their rivals of being "Irish solicitors, struck off the rolls 'for a cause,'"—should be lost to the world, is a thing to be regretted on every ground, scientific, literary, and social.

Mr. Menzies's book possesses great claims, both extrinsic and intrinsic. It is printed and got up in a style *de luxe;* and the matter which it contains is so clearly and pleasantly put forth, that the mind has as little difficulty in apprehending the writer's meaning, as the eye has in running along his liberally-interspaced, liberally-margined lines. Mr. Menzies's views are generally, as it seems to us, sound, and in keeping with those entertained by the majority of the engineering profession; and we do not know that, for the beginner, a better introduction to the subject can be found than that which this book affords. It is right, however, to add that his views, very fully expounded in his work, as to having separate systems of sewers for the rainfall and for the sewage severally, are in direct opposition to the *dicta* of Mr. Austin, put out in 1857, as well as to those of Mr. Bazalgette, put out in 1866. Though we are by no means disposed to consider the alliterative *dictum*, "the rainfall to the river, the sewage to the soil," as an axiomatic truth, we may grant, towards the end of an article, that the question does admit of two opinions being held about it. Of this, however, Mr. Menzies's suggestion as to "destroying ammonia and other salts" of sewage "entirely," "by passing the whole through filters of *magnetic carbide of iron*," does not admit; and agreeing with Mr. Menzies

as to our need of "further researches from our chemists in this direction," we recommend him, *en attendant*, to expunge this sentence from the proofs of his second edition. Mr. Menzies's remarks as to the impossibility of merely local authorities making even industries, such as those of the water-mill and the river-dock, reduced though they are to insignificance by the development of the steam-engine and the railway, subservient to the interests of an entire river valley and its inhabitants, deserve serious attention. A Metropolitan Board, charged with the supervision of our rivers, would raise the temperature and increase the comfort and salubrity of whole counties; and to the establishment of some such agency, strong enough to tax equitably the claims for compensation which local interests will make, and to prevent provincial jobbery, we look forward with confident hope.

Carbolic acid is, according to Mr. Menzies (p. 35), not so favourable to vegetation as Mr. Macdougall has found it at Carlisle; and though he agrees with Professor Way* as to the fertilizing effects of the detritus of the streets upon sandy soils, we observe that his (possibly greater) knowledge of the character and composition of the Edinburgh paving furnishes him with a somewhat different explanation of its *modus operandi* there. It is assuredly a curious correlation—rather should we call it a providential arrangement—that where men congregate in great numbers, the refuse from their gas manufacture should furnish them with such a disinfectant as is carbolic acid; and that the very washings of the streets, worn into powder by passing and repassing wheels and feet, should render the barren sand capable of cultivation.

Of the ultimate triumph of the sanitarian creed, we will say, in conclusion, we entertain not the slightest doubt. Unbelievers will be converted and nuisances reformed; our houses will be made wholesome, our streets inoffensive, and our rivers pure. The strength of those who work, whether by head or with hand, will be less encroached upon by debility and depression; and the sum total of our years, and even of our happiness and enjoyment, will be increased perceptibly. Something, however, may be done to retard the consummation of the sanitarian victory, by the incautiousness of the sanitarians themselves. The best cause is injured by an over-statement, and the following assertion, at p. 179 of the evidence given before Lord Robert Montagu's Committee, partakes somewhat of the character of an over-statement. The witness whose evidence is there recorded, speaks to the following effect:—"My experience is, that if you compel the detention of the refuse of cesspools in the vicinity of human dwellings until putrescence has set in, you as certainly manufacture fever as two and two make four." Now, we do think it highly probable that accumulations of festering

* Professor Way: Evidence Lord R. Montagu's Committee, p. 214.

filth may, under certain conditions, actually generate fever, without the entrance of any such fresh agent as a "specific cause" from without; but between being "highly probable," and "as certain as that two and two make four," there is a good deal of difference. The fact is, that the question of the spontaneous generation of fevers is, like the yet larger question of the spontaneous generation of organic living forms, still a moot point, though it cannot be said in this, as in the larger question, that the "Panspermist" has the weight of authority on *his* side. In a thickly-populated country like ours, it must always be possible for the seeds of any disease to be carried any whither; and a "Panspermist" ought not to be less vigilant in rooting up what, on his view, would be the necessary *nidus* for his *germs*, than the man who believes, as we incline to believe, that the "*nidus*" itself can produce the eggs. The question, therefore, is not necessarily a practical one; there are diseases enough which have their parentage referred, by all but bad landlords, to bad drainage, and with Dr. Parkes's well-balanced statement of the case we close it. At p. 28 he says, "To sum up: the diseases produced by fœcal emanations on the general population seem to be diarrhœa; bilious disorders, often with febrile symptoms; dyspepsia; general malaise and anemia—all these being affections of digestion or sanguification; *typhoid fever also is intimately connected with sewage emanations, either being their direct result, or, more probably, being caused by specific products being mixed with the sewage.* In addition, sewer-air aggravates most decidedly the severity of all the exanthemata, erysipelas, hospital gangrene, and puerperal fever, and probably has an injurious effect on all other cases." On the other hand, recent inquiries have shown that certain so-called "facts" alleged by the anti-sanitarians are, in reality, no facts at all. It has been said by these lovers of darkness, that workmen in sewers are not more subject to fevers than other labourers; but on close analysis it has been shown—first, that these men really are less healthy than their brother operatives; and, secondly, that no account had been taken in the examination and enumeration of healthy sewer-men of the protecting influence which previous unrecorded or unrecognized attacks of fever had conferred upon them; and, lastly, that no set-off had been allowed for the working of natural selection, in weeding-out, at their very first entrance upon the employment, of such would-be sewer-men as had no innate aptitude for the function.

There is a fault of minor importance, in a scientific point of view, but still of much practical moment, into which several sanitarians have fallen, and which all would do well henceforward to avoid. This fault is a fault of style, and consists in the introduction of rhetorical language, of far-fetched metaphors, and even of sacred names into the somewhat earthy matters of which we have been

writing. The man of science recognizes such merit as the evidence may possess, in spite of the masquerading dress it wears—the man of business is prone to turn a deaf ear to it altogether, because of this disguise and disfigurement. The former looks upon such an exhibition as something analogous to the aberrations of form which under certain circumstances beset the crystallization of certain salts, and the grotesqueness of the form assumed blinds him in neither case to the real nature of the substance before him. It is the sweeping style just now mentioned to which he objects, as he judges by sense and not by sound, whereas it is the stilted style which is an abomination to the chairman of a Parliamentary Committee, and may cost the cause which is advocated in it his help, his influence, and his vote.

IV. ON THE ANTIQUITY OF THE VOLCANOS OF AUVERGNE.

By Charles Daubeny, M.D., F.R.S., Professor of Botany at the University of Oxford.

(*Illustrated.*)

Accustomed, as we are, from our earliest infancy to have the first elementary truths of astronomy instilled into our minds, we can scarcely realize the idea, that nations, even in an advanced state of mental progress, were in the habit of viewing our relations to the celestial bodies around us in quite a different light from that in which they present themselves to us at the present time.

Almost every child who has had a few months' instruction in a parish school knows, that the earth turns round the sun, that the circle which bounds our horizon is not the limit of the universe, that the moon revolves in an orbit, which, although unapproachable by us from its distance alone, is near in comparison with the space which divides us from the sun, and yet that this great luminary is placed, as it were, within our own immediate neighbourhood, as compared with the distance which separates us from even the nearest of the fixed stars.

But these persuasions have grown up within a very recent period, and are due to the slow infiltration of philosophic truths into the minds of the vulgar, gradually displacing the earlier notions which had been acquired through the apparent testimony of our senses.

In the most flourishing periods of ancient Greece and Rome, in mediæval times, and even in ages approaching to our own, the same belief did not exist; nor, indeed, was a knowledge on such subjects a part of what the Almighty thought fit to impart by supernatural means to his chosen people.

Now, when it required so many centuries of research to indoctrinate the public mind in more enlarged ideas as to space, it cannot be a matter of surprise that geology, a science of much more recent date than astronomy, should not yet have succeeded in instilling more correct notions as to the extent of past time.

Without going back to times when this science was so much in its infancy, and was so little listened to out of doors, that the great body of the laity, as well as of the clergy, imagined the earth, as well as all the other celestial bodies, to have been called into existence by the direct *fiat* of the Almighty within the space of six literal days; and when it was taken for granted that the period which had elapsed since the creation of the universe was comprehended within the 6,000 years which, according to Archbishop Usher's calculations, had elapsed since the birth of Adam, I can myself recollect when geologists of reputation, whilst contending that the days of creation must have embraced an extended duration, rather than a compass merely of twenty-four hours, took it for granted, nevertheless, that the latest epoch in the history of our planet—namely, that during which the climate and configuration of the earth's surface corresponded in its general features with those it exhibits at present—was ushered in by the appearance of man upon the globe, and consequently could not be traced back to an earlier date than that which on Scripture authority had been assigned for the first introduction of our species.

Upon the subject of man's antiquity I shall not enter; but with regard to that of the earth itself I may remark, that subsequent investigations have compelled us to enlarge very materially the allowance of time formerly allotted for its formation. They have shown us at least that if what is called the post-pleiocene epoch is to be estimated as dating its commencement from the setting in of that intense cold which characterizes what is called the glacial period, if to a temperature such as allowed of the growth of subtropical plants had succeeded in the same latitudes as those of our own island, one as rigorous as that of Labrador at present, and if afterwards a gradual change supervened, by which the climate came by degrees to be assimilated to what we experience at present, a longer interval must be supposed, than our received systems of chronology, built upon the assumption that man was a denizen of the earth throughout the whole of that period, would allow us to recognize.

And yet the time taken up in this the latest of the world's stages of progress, if I may so express myself, may bear no larger proportion to that occupied by the whole series of formations from the first dawn of organic life upon the globe to the present time, than the distance in space between us and the moon bears to that which intervenes between our planet and the sun; just as even the time taken up by the deposition of all the rock formations, collectively considered, shrinks as much into insignificance by the side of

that required, according to the computation of mathematicians, for the cooling down of the earth from its original vaporous or incandescent condition, to a temperature such as admitted of the existence of life, as the distance between ourselves and the sun does to that which divides this luminary from the nearest of the fixed stars.

Thus, let us call the circumference of the globe,

1.

Then the distance from the earth to the moon will be

10.

Distance from the earth to the sun,

400.

Distance from the sun to the nearest of the fixed stars (*viz.* 61 Cygni) will be

160,000.

And, calling the distance from the present time to the birth of Adam,

1.

The distance from the same to the commencement of the post-pleiocene epoch would be

10.

Distance in time from the commencement of the post-pleiocene epoch to that at which organic life began would be

400.

Distance in time from the commencement of organic life to the period when the earth was first created, would be

160,000.

I have been led to these general remarks by the subject which has been proposed for the present communication, in which it will be attempted to show that the phenomena presented by the extinct volcanos of Auvergne tend in a very marked manner to corroborate the inferences which, on other grounds, I have deduced with regard to the long space of time that must have been consumed even by that one stage in the earth's history which connects itself most nearly with the present, not to speak of that almost interminable series of antecedent deposits which contribute to make up the entire crust of the globe.

In order to render this subject more intelligible, it will be necessary for me to enter into some details, which may appear to some rather egotistical, as they will involve an account of my earliest visit to Auvergne, which took place in 1819, before any other British geologist, since the peace with France, had explored the district.

I had come at that time fresh from the lecture-room of Professor Jameson, of Edinburgh, who was regarded a great authority in Geology, partly from the accurate knowledge he possessed of the characteristics of rocks and minerals, and partly as being one of the very few of our countrymen who had studied under Werner, the great Freyburg Professor, whose opinions respecting the structure and formation of the globe gave the law at that time to all who had studied under him.

Although in the lore which he had imported from his German master there was no small admixture of hypothesis, and that, as we now conceive, of a very crude and gratuitous character, yet the Professor contrived to impress his pupils with a high idea of the soundness of his instructions, not only for the reasons already assigned, but also from his dry and didactic manner, which seemed to preclude the notion of anything like fancy or imagination intermingling in the circle of his ideas. Coming forward indeed as the British representative of the Wernerian School of Geology, he felt it incumbent upon him in his lectures to exhibit the greatest possible antagonism to the treatises of Hutton, Playfair, and others of his countrymen who had appealed to Vulcan and Pluto as the main Artificers in the formation of the globe. With this view he founded, in opposition to the Royal Society of Edinburgh, where the Huttonian theory maintained its ascendancy, a new one, consisting chiefly of his own friends and adherents, which was denominated the Wernerian; and in order to render more patent the contrast between his mode of teaching and that of his opponents, he adopted the term Geognosy instead of that of Geology, by way of implying that his views were based upon observation, whilst theirs had drawn largely from the regions of imagination.

Now Werner had carried the Neptunian theory, as it was called, to such an extent, as to regard as deposited from aqueous solution, not only granite, but even basalt and traps of every form and description; and inasmuch as in Saxony from whence his observations were chiefly derived, the trappean rocks occur in vast tabular masses overlying the other strata, he imagined the former to have been deposited in consequence of a great inroad over the land, of water, carrying with it in solution the materials of which these rocks consist, so that the retiring flood left behind it on the summits of the highest ground it had reached those great deposits of trap which are found at this elevation.

And Werner's disciple, Professor Jameson, so far conformed to the creed of his master, that he stoutly maintained the aqueous origin also of all those formations of trap and porphyry which assume such gigantic proportions in various parts of Scotland, in the Hebrides, and in the north of Ireland.

In spite of the striking contrast which these rocks in their lithological characters present to ordinary deposits from water; in spite of the resemblance they bear to the products of fire; in spite of their intrusion into other strata in a manner which conveyed the idea of their former liquidity; and in spite even of the changes they often appear to have wrought upon the beds in contact, indicative, as it would seem, of fusion, Professor Jameson persuaded his pupils that the Wernerian theory was to be extended to them as well as to the rest.

But Auvergne, a region which had been already explored by

Von Buch, then a young and rising geologist of the school of Werner, exhibited phenomena which seemed to many of us scarcely reconcilable with this conclusion; for whilst we were told of rocks existing in that district which were scarcely distinguishable from the traps of Scotland, we learnt on the other hand, that these same formations were found in intimate connection with craters of extinct volcanos and with the scoriæ ejected from them, forming even a part of the streams of lava which had descended from these igneous vents.

In undertaking, then, a journey through Auvergne, one especial object I had in view was, to see how far I could reconcile the Wernerian doctrine, which had been instilled into me by my late preceptor, with the facts that had come to my knowledge with reference to this particular district.

But although I started on my expedition just after I had been sitting at the feet of my Scotch Gamaliel, I had also in previous years derived instruction in geology from quite a different kind of teacher, having attended the lectures of Professor Buckland, at Oxford, which, although not professedly antagonistic to those of Jameson, exhibited the subject under quite a different aspect, both from his mode of treating it, and from the opposite character of his mental constitution.

Whilst Professor Jameson confined himself for the most part to a description of the older rocks, and considered them chiefly with reference to their lithological characters, Professor Buckland drew his illustrations chiefly from the modern, as his main interest lay in tracing the successive revolutions which the earth had undergone, as determined by the changes in organic loss revealed to us by their petrifactions, as well as by the erosion of valleys, the transportation of erratic blocks, and the dispersion of gravel over the low ground.

Amongst the many catastrophes which he so vividly depicted, the latest, according to his reckoning, was that Deluge which Holy Writ had recorded, and which, instead of being confined (as many divines at the present day are content to regard it) to those regions which were actually peopled by man, had, as he conceived, left traces of itself in every part of the globe.

Those only who, like myself, can recollect the early lectures he delivered in the old Ashmolean building, to which Academics of all degrees of standing, from the Freshman to the Head of a house, flocked from every College and Hall of the University, can form an idea of the interest he inspired in this new study, by that union of vivid description, extensive knowledge of details, boldness of speculation, drollery, and enthusiasm with which he fascinated the minds of his hearers.

I may observe, however, that not only in those lectures of his which I attended in the years 1815 and 1816, but long subsequently, as in his 'Reliquiæ Diluvianæ' published in 1824, the Professor appealed to the organic remains contained in caves, fissures, and

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diluvial gravel, and to other phenomena, as attesting the action of an universal deluge.

And such was the influence upon the scientific world which he commanded by the zeal, eloquence, and research which he displayed in carrying out his favourite hypothesis, that diluvial action, diluvial gravel, diluvial pebbles, diluvial detritus, and the like were for many years received amongst the household words of geologists both in England and on the Continent.

It is true, that the scientific evidence by which he supported the notion of an universal deluge broke down upon further inquiry, and thus an early lesson was afforded us of the imprudence of pressing hastily into the defence of religion even the most plausible inferences deducible from the facts of science. The risk of thus prejudicing the cause which it was intended to uphold, by the re-action produced upon the mind from the subsequent exposure of the fallacies involved in the argument advanced, has been lately pointed out by Dr. Pusey in his discourse on 'The Relation of Science to Religion,' delivered at the Norwich Church Congress, and will, I believe, meet with general assent amongst men of science as well as theologians of all parties.

Still at the time I first visited Auvergne, the position that the valleys had been excavated by the action of the Noachian deluge reigned undisputed; and thus I began my explorations in that district with a mind prepossessed, not only with the doctrine of the aqueous origin of trap which I had derived from my Edinburgh preceptor, but also with the idea that the valleys in every country were the results of this supposed catastrophe.

It did not require more than a few days' sojourn in Auvergne to disabuse my mind of the former opinion, for the association of rocks undistinguishable from the traps and porphyries of Scotland, with craters, lava streams, and heaps of scoriæ, which plainly attested the operation of volcanic heat, soon convinced me that the Wernerian doctrine as regarded the origin of basalt was untenable.

But the theoretical views which I imbibed from my Oxford instructor were not so easily got rid of; for the phenomena presented by the volcanos of Auvergne proved of a nature to afford an apparent confirmation of the distinction which Dr. Buckland had set up between rocks formed *before* and *after* the Noachian deluge, or, according to his nomenclature, those of ante-diluvial and post-diluvial origin.

The volcanic rocks which we observe in this part of Central France may be separated into two classes, both by the difference in their external characters, and also by their position with reference to the surrounding strata.

The first class consists of those which have been cut through by the existing valleys like the other rocks of the district; the second, of those which follow the inequalities of the surface, so as to prove

that they were ejected since the country had acquired its present configuration in all its important features.

Subsequent observations have, indeed, shown that no sharp line of demarcation exists between the two, as there are instances of volcanic rocks which, although they have descended the slope of a valley, were themselves scooped out to a great depth by the same agency. But that the distinction can be clearly traced in many instances cannot, I think, be disputed by any who have visited the locality.

Moreover, a great difference exists between the two classes in their external characters, the former possessing in general the compactness and stony aspect belonging to trap and prophyry, the latter that cellular, glassy appearance and harsh feel which characterize modern lavas.

The former accordingly support a luxuriant vegetation, whilst the latter are scarcely decomposed by time, and therefore afford but little pasturage, and that generally of the worst description. The former, too, constitute extensive sheets of rock spreading over large districts, and cannot be traced to any point of issue, whereas the latter may generally be found to emanate from a crater, from which they proceed into the lowest ground contiguous, in a stream, the breadth of which bears no proportion to its length.

In accordance, then, with the views prevalent at the time I first visited the country, the former class would be entitled to the name of ante-diluvial, and the latter to that of post-diluvial, the one being regarded as produced before the great catastrophe by which the valleys of the country were then conceived to have been excavated, the latter subsequently to that event.

It therefore became a question of some interest to determine whether any records existed which should indicate the continuance of the activity of the Auvergne volcanos down to the period of authentic history. But on this point classical authorities are silent.

Julius Cæsar, by no means inattentive to the external features of the countries he invaded, makes no allusion to any volcanic phenomenon having arrested his notice, although he encamped upon the plains of Auvergne, and laid siege to Gergovia, the principal city in the district.

His silence, however, it may be said, only proves that during the period at which he was engaged in that part of Gaul the igneous forces were slumbering, as might have happened in the case of Etna or Vesuvius during any such short interval of time.

But what shall we say of the omission of Pliny to include Auvergne amongst the regions in which he records the existence of fiery mountains; and what of the silence of Strabo on the same point? to say nothing of the poets, who indulge in such frequent mention of Etna and Lipari, but make no allusion to volcanos in other portions of the then known globe.

And yet of all natural phenomena a burning mountain is the one which in all ages most forcibly rivets the attention of the multitude, and of which the memory is longest retained by tradition, or by means of the popular fables engrafted upon it.

The volcanic fire once raging near Lemnos, about Santorino, in Argolis, and elsewhere, is made the subject of many a poetic legend, and even less formidable phenomena of the same kind, such as the bursting forth of flames from the ground, are carefully recorded by the naturalists of Greece and Rome.

The most convincing proof, however, that the volcanos of Central France were not in activity so late at least as the fourth century of the Christian era, or at any period antecedent to this, which would be included within the range comprised by the histories or the traditions of the country, is afforded by the absence of all allusion to such phenomena in the existing works of Sidonius Apollinaris.

We learn from some of his writings which have come down to us, that he had a palace on the borders of Lake Aidat, in the very midst of the volcanic region alluded to. In one of his poems he celebrates the beauties of this residence, and compares it to his former abode at Baiæ, near Naples; but not a hint escapes him that he had ever witnessed or even heard of any volcanic eruption in his neighbourhood, although he must have been familiar with the nature of such phenomena, from having previously resided in the neighbourhood of Vesuvius.

And yet the very lake near which his episcopal palace stood, owed its origin to one of the more recent, or, according to Dr. Buckland's hypothesis, of the post-diluvial eruptions, one which, invading the bed of the little River Sioule, by the stream of lava it sent out, raised a barrier across it, and ponded up its waters, until they accumulated to such an extent as to form a considerable sheet of water.

It was on these grounds that in the account I published in 1819 of this my earliest visit to Auvergne, I concluded that although some of the volcanos of this country might have been in activity since the epoch of the Noachian deluge, they must all have been extinct before the Roman invasion; and this conclusion was assented to by Mr. Scrope, Sir Charles Lyell, and other geologists, who afterwards explored the district.

Nevertheless, in the year 1844, a different view of the subject was advanced by an eminent historian and antiquary, Sir Francis Palgrave, who, in an article "On the Norman Conquest," in the 'Quarterly Review,' endeavoured to show by some quotations from the writings of Sidonius Apollinaris, and of Alcimus Avitus, Bishop of Vienne, that the volcanos of Auvergne had been in activity so late as the fourth century after Christ.*

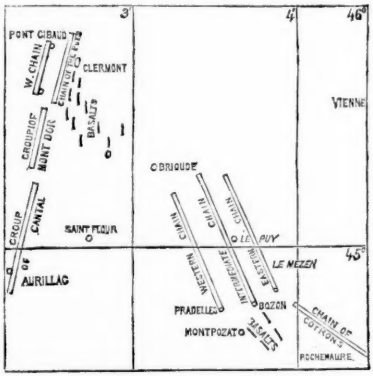
* Reference was made to Sidonii Apollinaris, Epist. 1; and Alcimi Aviti 'Homiliæ de Rogationibus.'

In reply to the arguments he advanced, I observed,* that although some of the expressions of Sidonius and of Alcimus Avitus quoted might seem at first sight to refer to a volcanic eruption, yet the following considerations would forbid of our entertaining such an hypothesis.

1. The city of Vienne, near which the physical convulsions alluded to were reported to have occurred, lies nearly seventy miles in a direct line from the theatre of volcanic action situated round Clermont.

The relative position of the city of Vienne to the nearest volcanic chain is shown in the accompanying diagram.

Fig. 1.



2. Had Sidonius ever heard of such events occurring in his own neighbourhood, he would scarcely have failed to refer to them, if not on other occasions, at least on this, in which he vividly depicts the alarming catastrophes that had occurred in a neighbouring province.

3. The city of Vienne stands upon gneiss, with the great coal formation of St. Etienne interposed between it and the rocks of Auvergne, and with a range of hills of considerable elevation intervening between the two.

4. The geology of France has been carefully explored by the labours of Elie de Beaumont and others; but no notice of anything volcanic in the vicinity of Vienne can anywhere be found in their descriptions.

5. No volcano could have burst out without leaving permanent traces of its occurrence in the craters and lava-streams which it must have produced.

* See my work, entitled 'Descriptions of Volcanos.' Taylor & Francis, 2nd ed., 1848, p. 31.

6. It is contrary to the analogy of other active volcanos, to suppose that an eruption should have broken out at such a distance from the sea as that at which the city of Vienne is situated.

7. Allowance being made for some little exaggeration in this part of the narrators, the descriptions both of Sidonius and of Avitus might apply to those dreadful earthquakes which, as we have reason to believe, from the subsequent testimony of Gregory of Tours, ravaged the whole of this district, and which may easily be supposed to have extended from the former seat of volcanic activity, in Auvergne, to a neighbouring province, just as the most fearful earthquakes in Sicily are experienced, not at Catania, but at spots as far distant from Etna as Palermo.

The underground thunder, the opening of fissures in the ground, the bursting-out of flames and gases, the projection of water and of stones, the smell of sulphur, the alarm evinced by the animals of the spot and neighbourhood, the elevation or depression of the land, noticed by Sidonius and by Avitus in the passages referred to by Sir Francis Palgrave, are all reported as concomitants of the great earthquakes which have occurred in more recent times.

On the above grounds I continued sceptical as to the late date assigned to the volcanos of Central France, even after weighing the arguments which Sir Francis Palgrave had brought forward in support of his opinion; and as this distinguished writer never appears to have replied to my arguments (although in his 'History of Normandy,' published in 1856, he briefly reiterates his statement, without, however, remarking upon the grounds which had led him to adhere to it), I considered the question to be set at rest, until last year, when the controversy between Bishop Colenso and his antagonists, relating to the accuracy of the historical portions of the Pentateuch, unexpectedly led to its revival.

The Bishop, it seems, contended, that if the deluge recorded in Genesis had been universal, it must have swept away those cones of loose scoriæ which are found in many parts of Auvergne, the great antiquity of which he inferred, amongst other reasons, from the admitted fact, that all volcanic action had ceased in the country before history commenced.

To this his opponents replied, by appealing to the evidence already got together by Sir Francis Palgrave, in proof that such operations had continued there as late as the fourth century after Christ.

Now, with reference to the question at issue between the Bishop of Natal and his opponents, it seems to me to matter little which side of the controversy is espoused; for, on the one hand, supposing it to be established that the volcanos of Auvergne had continued active as late as Sir Francis Palgrave imagined, it would still remain to be ascertained whether those particular outbreaks to which Colenso had appealed could be referred to a date subsequent to the Noachian deluge.

And on the other hand, supposing it probable that all traces of igneous operations had ceased before the earliest period to which history points, there would still be an ample margin left between that and the supposed date of the Flood, to allow of these outbreaks having taken place.

Let us, then, enter upon the inquiry with minds unswayed by any theological bias, and simply consider whether it be probable that, in the passages above alluded to, anything of the nature of a volcanic eruption could have been intended.

And for my own part, as no new arguments have been advanced in support of those alleged by Sir Francis Palgrave, I feel still at liberty to adhere to the opinion which had been taken up long before its possible bearing upon any polemical question was dreamt of, and to maintain, as I did in the year 1819, that the volcanos of Central France have not been shown, by evidence yet adduced, to have been in activity at any period within the range of history or tradition.

And now, having, as I hope, disposed of this previous question, let us proceed to consider whether that class of volcanos which I denominated *post-diluvial*, but which I shall now merely designate as, by comparison, *modern*, presents any characters indicating great antiquity.

In fixing their age, I have derived great assistance from the researches of those eminent geologists who, since the period of my first visit to Auvergne, had explored the district in question, and especially from those of Mr. Scrope, who appears to have spent there the summer of 1821, and of Sir Roderick Murchison and Sir Charles Lyell, who went through the country in 1828.

From the descriptions given by these and other competent authorities, it plainly appears that the valleys in Auvergne were excavated, not at one, but at several successive periods—or, more correctly speaking, that although water was instrumental in their formation, yet that they must have been scooped out, not by any violent movement or sudden passage of a flood over the country, but by the long-continued action of the rivers now in existence.

And if this be the case, it follows, that there can be no abrupt line of demarcation between the older and the more modern volcanic products, and that even those which have been ejected since the formation of the principal valleys, may nevertheless afford evidence of extreme antiquity.

It is but fair to attribute to Mr. Scrope our first correct notions on this subject.

His 'Memoir on the Geology of Central France,' published in 1827, evinces a just idea of the mode in which its valleys were formed, as well as a clear appreciation of the amount of time which must have been occupied in their excavation, and his Work is illustrated by a number of interesting panoramic views, which bring vividly

before us the general Physiognomy of the country, so as better to enable us to realize the force of the evidence he had brought forward.

To this work, and to the memoir of Lyell and Murchison, 'On the Excavation of Valleys, as illustrated by the Volcanic Rocks of Central France,' I am chiefly indebted for the few facts the space allotted me admits of my bringing forward in proof of the great antiquity even of the more modern class of eruptions.

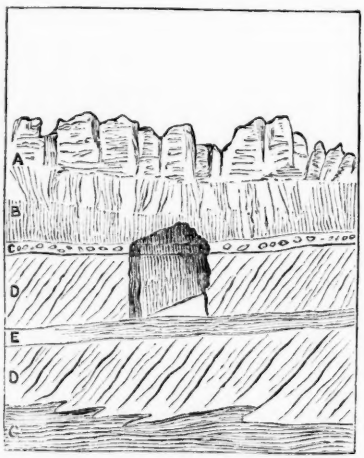
Let us take the case of the volcano of Chaluzet, near the village of Pont Gibaud.

This is a conical hill, composed of red and black scoriæ, having on its summit a depression resembling a worn-down crater, from which may be traced a powerful stream of lava descending into the valley below, in which the river Sioule flows. Deflected to the north-west by the lofty and serrated ridge of gneiss which forms the right bank of the stream, the lava-current follows its course as far as "Les Combres," where it terminates.

The upper portion of the mass is scoriaceous, the lower compact and prismatic, and the under-surface of the prisms stands at a height of about 50 feet above the present bed of the Sioule, resting upon a bed of pebbles.

The pebbles have indeed been traced some way into the rock, in consequence of a gallery driven in horizontally through the upper part of the gneiss and the interposed alluvium, so as to render it clear that the lava-stream really rests upon the latter.

Fig. 2.



A. Scoriaceous Lava.
B. Columnar Basalt.
C. Bed of Pebbles.
D. Gneiss.
E. Path.
G. River Sioule.

The annexed drawing, taken from Sir Roderick Murchison and Sir Charles Lyell's paper 'On the Excavation of the Valleys in Auvergne,' will illustrate the relative position of the lava-current and gneiss in this locality.

Hence it follows, that since the period at which the lava was ejected, a thickness of 50 feet of solid gneiss must have been excavated.

Now the slowness with which the present river erodes a material of this description may be estimated by a fact pointed out by Sir Charles Lyell in the same province, near St. Nectaire, where an ancient Roman bridge spans the River Couze, over a stream of lava, proceeding from a volcanic hill,—the Puy de Tartaret,—showing that a ravine, precisely like that now existing, had already been excavated by the river fourteen centuries ago.

And yet the lava of the Puy de Tartaret presents all the appearance of a modern current, both from its having conformed to the sinuosities of the valley, and also from its covering a bone deposit at its bottom, indicating a mammiferous Fauna, which, although distinct, as a whole, from that now inhabiting Auvergne, presents some features in common with it, as in the existence of the dog, deer, cat, &c., mixed with the remains of the reindeer, which, even so late as the time of Cæsar, appears to have been found in the Great Hercynian Forest, and also with an animal of the horse tribe, differing, however, in some points from the species now living.

But it is in the neighbouring province of the Vivarais that the most remarkable instances of the long-continued action of water slowly eroding to a great depth streams of lava which have flowed at a comparatively recent date, are afforded.

Before describing these, however, I must point out a circumstance which distinguishes a current of lava from one of water, namely, that from its viscid character it has a tendency, near its termination, to accumulate layer upon layer, so that its materials are piled up to a considerable height, instead of spreading onwards, as would happen to a substance of more perfect fluidity.

Hence, when a lava stream reached the bed of a river, it sometimes formed a precipitous bank on one side of it, without appearing to have advanced to the other.

Of this, indeed, several examples are met with in Auvergne, but the most remarkable cases are those to which I have alluded in the Vivarais.

In that province, Mr. Scrope enumerates no less than six perfect volcanic cones, with craters on their summits still preserved in a state of greater or lesser integrity, from which have proceeded streams of lava, each of which may be traced down the sides of the mountain, and are seen to terminate abruptly at its foot.

Now, when the bottom of the valley is occupied by running water, its bank is walled in by a colonnade of basalt, extending for a considerable distance along its margin, derived from the lava stream which had descended from the mountain above.

It is true that when, as sometimes happens, the igneous mass is not perceived on the opposite bank of the river, as is the case at the Coupe de Col d'Aisac, of which a description and drawing has been given by Faujas St. Fond, we have no right, for the reasons above stated, to ascribe the entire height of the vertical cliff of basalt to the eroding force of water; but, in other cases, as at the spot called the Gravenaire of Montpeset, of which Mr. Scrope has given us a drawing, there can be no mistake about the matter, as a high, precipitous rock, upon which the ruins of a castle stand, is severed from the main body of the lava current, and rises up in the midst of the stream. The upper portion of this rock is composed of basaltic lava, derived from the mountain above and forming the termination of a current which had flowed from it; but the lower consists of gneiss, which, since the lava current had been erupted, is seen to have been excavated by the erosive power of the stream to the depth of 100 feet. The time necessary to bring about this effect I will not pretend to estimate, but may appeal to it as a proof of the great antiquity of a lava current, which must have, at least, been antecedent to its commencement.

One very remarkable peculiarity of the lava streams in the Vivarais currents is their basaltic character and their prismatic structure. We are accustomed to consider trap rocks in general, and more especially that particular description which is denominated basalt, as exclusively the product of submarine volcanos, their compactness being said to arise from the great pressure exercised upon them during their consolidation. But in this part of France we meet with several instances of basaltic colonnades, which have been evidently derived from streams of lava ejected from sub-aerial volcanos.

It is true that, in all those specimens which have come under my notice, minute cells and cavities may be discovered by careful examination, and, moreover, that the upper portions of the bed are more pervaded by them than the lower.

Still the resemblance which they bear to the products of submarine volcanos is very remarkable, and only admits of being explained by the thickness of the bed and the weight of the scoriæ superimposed, for it evidently matters not in what way the pressure is produced, provided it be sufficient to retain the aqueous and other volatilizable ingredients present within the rock in such a condition as to prevent the production of cells and cavities.

And, accordingly, it is observed, that this compact character and

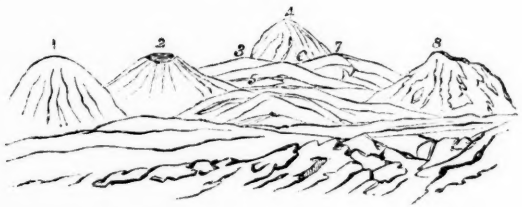
columnar structure are not met with in those parts of the current which occupy the slope of the mountain, but only at its termination in the valley below, and that even there these characters are confined to the lower portions, where the pressure must have been greatest, the basalt being surmounted by a considerable thickness of cellular lava of the usual kind. Moreover, a difference can be traced in the degree of its compactness according to the relative position which the specimen holds in the basaltic bed, the upper layers being the most cellular.

In the Vivarais, then, as well as in Auvergne, we have abundant instances of lava streams, which, although amongst the most recent the district affords, being poured forth at a time when the general configuration of the country had become nearly what it is at present, exhibit, nevertheless, traces of their high antiquity, from having been subjected to the long-continued operation of denuding agents.

Where these agents have been at work their relative date may be fixed, but we do not appear to possess the same means of referring to a particular epoch the five isolated domes of trachyte which occur on the tableland to the west of the city of Clermont, although the occurrence of free muriatic acid in one of them would imply that they were modern.

These conical hills, of which the loftiest, called the Puy de Dôme, rises to the height of 4,842 feet, or 3,554 feet above the level of Clermont, seem each to have proceeded out of the midst of a kind of crater formed by volcanic rocks of the usual character and appearance, and therefore bearing no analogy to the material of which they are themselves principally constituted. Their general appearance is represented in the annexed woodcut, from a drawing of Scrope's.

Fig. 3.



They seem to bear some resemblance, although on a much larger scale, to the Bosses or *Mamelons*, to use a French phrase, protruding from the midst of the craters of Rocca Monfina, near Terracina, and of Astroni, near Naples, which may perhaps be paralleled by those dark spots observed by astronomers in the midst of the circular hollows existing on the surface of the moon,

which Sir John Herschel and others have regarded as volcanic craters. Without discussing the mode of their formation, which would detain us too long, it may be enough to say that they would seem to be more modern than the amphitheatre of volcanic rocks which encompasses them, though their elevation, which places them far beyond the reach of the eroding action of rivers, prevents our fixing with any certainty the degree of their antiquity.

Let us therefore pass from these problematical rocks to others of far greater antiquity than any that have yet come before us.

They may be divided into two classes—namely, those of a basaltic and of a trachytic character, and of these the latter seem in general to lie lowest, having the basaltic superimposed.

But since the trachyte at the same time rises to the most elevated points in the country, as at the Pic de Sancy, near the Baths of Mont Dor, where it attains the height of 6,217 feet above the sea, and in the neighbouring department of Cantal, where it reaches, at the summit of the Plomb de Cantal, that of 6,096, the basalt seems in some places to lie beneath it.

Although volcanic, these rocks bear but a remote resemblance to the rocks above alluded to; for not only are the materials of which they are composed in general more compact, but when scoriform, they consist for the most part of pumice, a material not met with, it is believed, amongst the more recent class of volcanos.

Still more distinct, too, is their general structure; for, instead of constituting streams of lava traceable for the most part to a crater as their point of issue, they are spread out into vast sheets, extending continuously over wide areas, in some places indeed rising to a great elevation, but even then exhibiting no traces of anything which bears the slightest resemblance to a crater.

Indeed, so contrasted are the general characters of the volcanic rocks we are considering, with those in the neighbourhood of Clermont, that Messrs. Dufrenoy and Elie de Beaumont, the French geologists alluded to, conceived that their structure may be best explained upon the supposition, that they had been first spread almost horizontally over the surface of the subjacent gravel, and afterwards were upheaved at three different points, the Pic de Sancy being the centre of one elevatory movement, Roche Sanadoire of a second, and the Puy de la Tache of a third, these representing the highest spots in the vicinity of the Baths of Mont Dor, around which the supposed elevatory movement took place.

Now the deep valley in which these Baths lie is conceived by these same geologists to have been originally formed, not by the erosion of water, but by a disruption of the rocks on either side, consequent upon the elevation of the range at these three several points.

If this theory be adopted, we are precluded, of course, in this instance, from appealing to the great depth of the valley, at the bottom of which the Baths stand, as indicative of the time required for eating so deeply into the substance of the volcanic rocks which bound it; but other proofs of great antiquity are not wanting, such as the existence of conglomerates consisting of rolled pebbles, which underlie one volcanic bed and which support another, as well as of tuffs containing fragments of the trachyte and basalt of the neighbourhood.

In some places, also, as in the Department of Cantal, fragments of limestone containing impressions of plants are scattered through these trachytic conglomerates.

And it would be a bold thing to maintain that, whatever may have been the case with the particular valley alluded to, none of the others which score the sides of the volcanic tableland have been due to the action of water, or even that such as have been originally produced by upheavement were not subsequently modified by denuding agents.

In short, the same arguments which induce geologists to assign a very long duration to those operations of nature which have in other countries scooped out the valleys and moulded into its present form the earth's surface, apply equally to the case of that more ancient volcanic region in Central France which has been just alluded to.

Everything therefore concurs to bespeak a high antiquity for these formations, and to indicate a long-continued operation of denuding forces upon the beds of igneous matter since their eruption; and yet all these events must have been posterior to the formation of some at least of the fresh-water beds of the Auvergne country, formations which Sir Charles Lyell refers to the Eocene period, still a portion of the Tertiary or of the youngest Member of the great Family of rocks.

It seems indeed most probable, that these eruptions of igneous matter had broken out at the time when the district was covered by extensive sheets of fresh water, like the great lakes of North America, and hence may have been derived their greater compactness, as compared with the more modern volcanic products before alluded to, an indication of their having been erupted under a pressure greater than that of the atmosphere. And yet, when we recollect that in the Eocene period about $3\frac{1}{2}$ per cent. of existing species of molluscæ were already in being, whereas in the newest of the subjacent secondary rocks no one living form has been as yet detected, and when we consider, moreover, how many distinct races of animals and of plants, all of which have passed away, succeeded each other in periods antecedent to the first dawn of the Tertiary epoch, it must be admitted, that vast as was the time occupied in bringing about the

long series of igneous formations which we witness in Auvergne, it sinks almost into insignificance by the side of that period of incalculable duration which must have elapsed since the globe became first fitted for the maintenance of organic life.

And this leads me to another point of some general interest—namely, that volcanic action, notwithstanding its long continuance in one district, shifts its ground from time to time, so as probably in the course of years to visit in succession every region of the globe.

Before the close of the Eocene period, when the volcanos of Auvergne first came into activity, those of the Hebrides, of the North of Ireland, and of parts of Scotland had become extinct, and yet we have reason to believe that these last were for the most part contemporaneous with the chalk, and do not date back so far as the Oolite.

That they are entirely *burnt out*, may be inferred from the absence, throughout the whole space comprised within their several areas, of thermal springs, and of the severer forms at least of earthquake, which cannot be said of Auvergne; for the latter volcanos, though, as I believe, not in activity since the earliest periods of history, still give evidence of smouldering internal fire in their warm springs, evolutions of carbonic acid gas, and in occasionally recurring earthquakes of considerable intensity.

It would be easy to point out volcanic regions of still greater antiquity in other parts of the globe, which became extinct even before the igneous operations in the Hebrides, &c., had commenced; but it may be most to the purpose to note that in the highly vulcanized region of Southern Italy, the Apennine limestone, there so abundant, and of an age corresponding to the Jura or Oolite, exhibits no proof of igneous action having extended back so far as the period at which their beds were deposited.

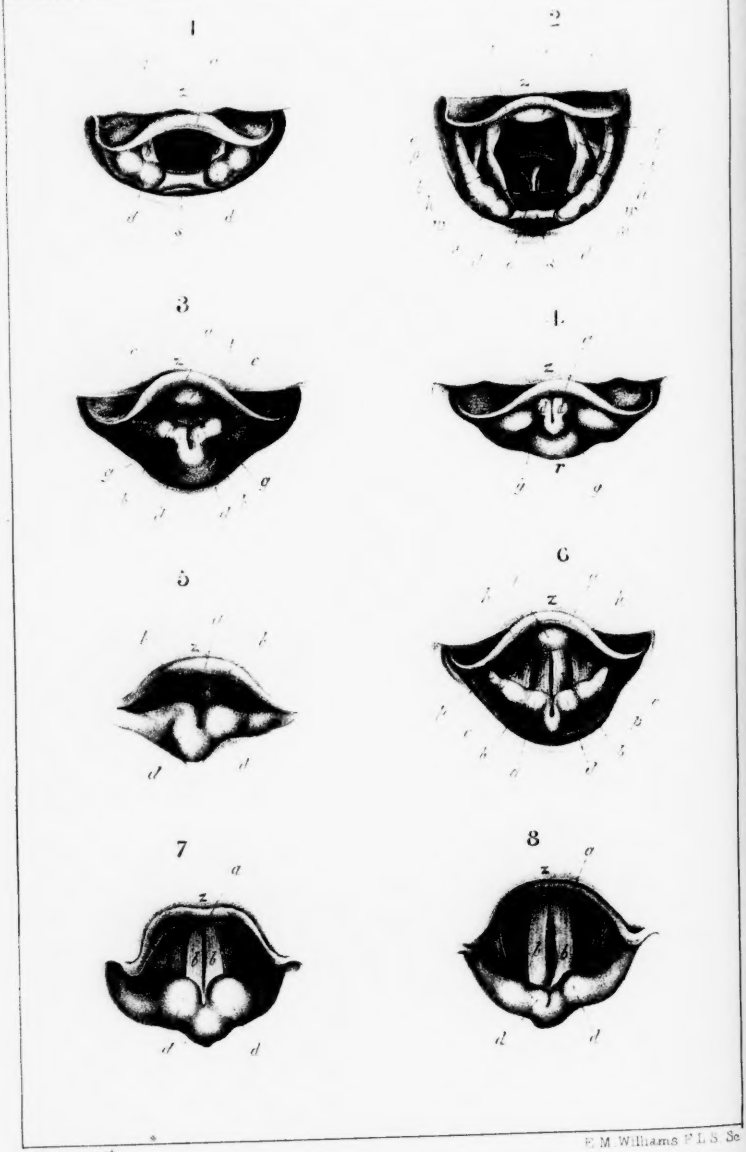
From these considerations it may be inferred, that every portion of the globe is destined at one time or another to become the theatre of similar catastrophes.

Perhaps in some future time a chain of burning mountains may show itself along the coasts of Scandinavia; perhaps Australia may hereafter experience some of those underground convulsions which are now so rife amongst the islands of the Pacific.

And if so, what an impression is conveyed to the mind as to the length of time which must have elapsed since the planet we inhabit was first called into existence, or, indeed, even as to the number of years which have rolled on since the commencement of organic life.

For from the period occupied by one only of these epochs, that which has been pointed out in Auvergne, we may form some slight estimate of the remainder, and the aggregate certainly presents an idea of past time which it is difficult for our limited faculties fully to realize.

XUM



C.B.Fox del.

F.M.Williams F.L.S. Sc

THE HUMAN LARYNX.

A few of the many Physiological changes observable by means of the Laryngeal Mirror

V. ON THE LARYNGOSCOPE, AND SOME OF ITS PHYSIOLOGICAL REVELATIONS.

By Cornelius B. Fox, M.D. Edin., M.R.C.P. Lond.

(*Illustrated*)

The Laryngoscope is, as its name implies, an instrument for the examination of the larynx or vocal apparatus, whereby we can not only study with facility the normal action of its various parts in the production of sound, but by which the abnormal and diseased conditions of this organ may be, in general, diagnosed with certainty. The Rhinoscope, for the inspection of the posterior part of the nasal cavities, and the Autolaryngoscope, for the examination of one's own larynx, are merely modifications of the Laryngoscope: a description of these instruments, however, does not fall within the compass of this paper.

1. *The History of the Laryngoscope.*—In 1743, a distinguished Frenchman, named Levret, employed himself in ascertaining the manner in which polypi of the nostrils, throat, ears, and other parts could be removed by ligatures. An illumination of these regions was produced by the aid of a polished plate of metal, on which light was projected and in which the illuminated parts were seen.

In 1807, a pamphlet was published at Weimar, by Dr. Bozzini, of Frankfort-on-the-Maine, on 'The Light Conductor, or a Description of a simple Apparatus for the illumination of the Internal Cavities and Spaces in the Living Animal Body.' This instrument essentially consisted of a number of hollow metal tubes, of various diameters, adapted to the different canals of the body, and of a lantern, to which they all could be fitted. Finding it necessary to employ reflected light in the examination of the larynx and posterior part of the nasal cavities, he had a speculum—at one end of which was a mirror—divided by a partition into two parts: one canal and half of the mirror serving to transmit the light and the other the image. Although he was evidently well aware of the means required for the examination of the larynx, yet his observations in this region seem to have been confined to the posterior part of the nasal cavities. In 1827, Dr. Senn, of Geneva, attempted to obtain a sight of the larynx of a child who was labouring under great difficulty of breathing by means of a small mirror, but was unsuccessful in his endeavours, because he did not illuminate the parts.*

In March, 1829, Dr. B. G. Babington exhibited to the Hunterian Society an oblong piece of looking-glass attached to a portion of silver wire, which he called a Glottiscope. By placing this instru-

* *Vide* 'Journal de Progrès,' 1829.

ment against the palate, and reflecting thereon the sunlight with a common back-hair glass, he saw the epiglottis and upper part of the larynx. He subsequently attached to the mirror a tongue-depressor, but after a time abandoned this addition, and substituted polished steel for the glass mirrors.* In 1830, Gerdy wrote, "La contraction du pharynx se vérifie aisément à l'œil au moyen du miroir."† In the year 1832, Dr. Bennati, of Paris, announced to the world the possibility of seeing the vocal chords by means of an instrument, in all probability exactly similar to, if not identical with, that of Selligue, to be immediately described.‡ Trousseau and Belloc, in their 'Memoire sur la Phthisie Laryngée,' published in 1837, refer to an instrument made by an ingenious mechanic, named Selligue, who was affected with that disease. It closely resembled that of Bozzini, consisting of "a double-tubed speculum, of which one tube served to convey the light to the glottis, and the other to bring back to the eye the image of the glottis, reflected in the mirror placed at the guttural extremity of the instrument.

These authors state that it was very difficult of application, and that not one in ten could bear its introduction. In 1838, Monsieur Beaumês, of Lyons, exhibited before the Medical Society of that city a mirror for the examination of the throat, larynx, and posterior part of the nasal cavities.§ The distinguished surgeon Liston speaks of obtaining a view of an "ulcerated glottis by means of a small mirror, similar to that employed by dentists, on a long stalk, and dipped in hot water before its introduction into the throat." ‖ In 1844, Dr. Adam Warden, of Edinburgh, read a paper before the Royal Scottish Society of Arts on 'The Employment of a totally reflecting Prism for illuminating the open Cavities of the Body.'

Having been very successful in his examinations of the auditory canal, he directed his attention to the larynx, which he made visible by the employment of an additional prism placed in the throat, and associated with an instrument for depressing the tongue and expanding the faucial cavity. He referred to two cases, in which he had obtained "satisfactory ocular inspection of diseases affecting the glottis," but evidently did not consider this mode of examination as one which promised much success.

From 1846 to 1848, Mr. Avery, of London, employed instruments for inspecting the throat, posterior part of the nasal cavities, and other regions. His Laryngoscope was a cumbrous piece of apparatus, worn on the head and nearly a pound in weight. It consisted—1° of a circular reflector, perforated in the centre, for

* *Vide* 'Lond. Med. Gazette,' March 28, 1829.
† 'Physiologie Médicale,' p. 503.
‡ *Vide* 'Recherches sur le Mécanisme de la Voix Humaine.'
§ *Vide* 'Compte Rendu des Travaux de la Société de Médecine de Lyons,' 1836-38.
‖ 'Practical Surgery,' 3rd edit., p. 417, published in 1840.

the concentration of the rays of light emanating from a candle fixed in front of it; and 2°, of a speculum attached to the opposite side of the candle, and containing at its extremity a laryngeal mirror. He seems, however, subsequently to have forsaken the speculum, and employed solely small laryngeal mirrors, "made of solid lumps of metal." He affirmed, that with his Laryngoscope he had occasionally been able to see the bifurcation of the windpipe. In the year 1850, the medal of the Society of Arts was awarded to him for his labours. Monsieur Desormeaux, of the Hôpital Necker, in Paris, has employed for many years past an instrument which resembles Bozzini's, for the examination of the urethra, posterior part of the nasal cavities, the throat, as well as other parts.* Monsieur Garcia, the eminent professor of music, was the first experimenter who succeeded in obtaining a sight of his own larynx. The method he employed was the following:—Placing himself with his back to the sun, he introduced into his throat a little mirror, attached to a long stem; on this he cast the rays of light by means of a looking-glass, and in this same glass he saw the reflection of his larynx. This mode of examination was precisely that of Dr. Babington, who, however, made no attempt at autolaryngoscopy. After having studied the mechanism of the human voice during singing, he presented a paper to the Royal Society of London, in 1855, entitled, "Physiological Observations on the Human Voice."†

This paper, meeting the eye of Dr. Türck, of Vienna, that gentleman was induced to employ the laryngeal mirror in the wards of the General Hospital in 1857, but apparently without the assistance of any illuminating mirror whatever. In November of that year, Dr. Türck, having ceased to employ his mirrors, lent them to Professor Czermak, of Pesth, who made the very important addition of a large circular mirror for the concentration of the light. This mirror was perforated in the centre, and so arranged as to bring the perforation in front of the pupil of the examiner's eye. Although many of Czermak's predecessors were acquainted with the principles, none of them completed the art. To him, then, who is named by Dr. Gibb the father of Laryngoscopy, is due the credit of having perfected the Laryngoscope and introduced it to the scientific world.

Czermak's first essay on the subject appeared in 1858, and was named 'Physiological Researches with the Laryngeal Mirror of Garcia.' This was followed by various papers, the most complete and comprehensive of which was published by the New Sydenham Society in 1861, and entitled, 'The Laryngoscope and its Application to Physiology and Medicine.'

Finally, the names of Battaille, Merkel, Semeleder, Stoerk,

* *Vide* 'De l'Endoscope et de ses Applications,' 1865. Paris.

† 'Proceedings of the Royal Society of London,' vol. vii., No. 13. 1855.

Gibb, and Mandl should not be omitted whilst referring to labourers in this field.

2. *The Instrument.*—The most essential part of the Laryngoscope is the laryngeal mirror. It should be made of silvered plate-glass, and set at an angle of 120° with its stem. It may be circular, or square with the angles rounded, and if from $\frac{6}{10}$—$\frac{8}{10}$ of an inch in diameter, will be found most generally useful. The illuminating silvered glass mirror ranks next in importance; it should be slightly concave, perforated in the centre, of about 3½ inches in diameter, and possessing a focal power of 14 inches. It is desirable to have the mirror attached to the frontal pad or spectacle-frame, by means of a ball and socket-joint, and so arranged as to be worn at pleasure, either in front of the eye or on the forehead. As to the light, nothing equals the solar rays; but as they are not always to be obtained, it is necessary to resort to artificial illuminating sources. The bright, steady flame of a good German lamp —especially if a Tobold's condenser is adapted to it – leaves little to be desired. A tongue-depressor is often requisite: one composed of vulcanite, with its under-surface serrated, so that some traction may be exerted on the tongue, is found by the writer preferable to any other form.

3. *Mode of employing the Laryngoscope.*—The individual to be examined should be seated upright in a chair, with the head slightly inclined backwards, the mouth widely opened, and the tongue protruded. If the solar rays are available, his back should be turned towards the sun, but if artificial light is necessary, the lamp should be placed on a table by his side, and at such an elevation as to be on a level with the ear. The observer, being seated immediately in front of the observed, and having his illuminating mirror on his forehead, or in front of either eye (in which latter case he gazes in the direct axis of the illuminating rays), should hold the protruded tongue firmly between the fore-finger and thumb of the left hand, previously enveloped in a cloth or handkerchief. The rays proceeding from the illuminating source are easily directed by a little adjustment of the mirror into the throat, having not only undergone reflexion, but concentration. The laryngeal mirror, being held like a pen in the right hand, is to be heated over the lamp, to prevent the condensation on it of moisture. Before its introduction, the temperature of the mirror should always be tested by placing it on the back of the hand or on the cheek, to prevent the possibility of burning the throat. Having been carefully passed over the base of the tongue, so as to avoid contact with that organ, it should be made to rest on and slightly raise the uvula—that is, if we wish to look vertically down the laryngeal tube. The base of that unruly member, the tongue, has very often a great tendency to rise towards the palate, thus obstructing both light and vision.

When in such a case an ordinary tongue-depressor is employed, it sometimes happens that the *extreme* base of this organ, which cannot be touched by the instrument on account of the retching excited, is unavoidably pressed backwards, and the glottis is thus closed by its lid, the epiglottis. An instrument which will not only depress, but one which will at the same time exert some slight traction on the tongue, such as has been already briefly referred to, is found very frequently serviceable.

A knowledge of the structure of the various parts of the larynx is, of course, indispensable to those who would study their functions, for one can then more readily understand the different appearances observable in the laryngeal mirror.

The condition of the larynx in a quiescent state during ordinary tranquil respiration is represented in Fig. 1. The glottis is seen to be freely opened, and one observes a large portion of the anterior wall of the windpipe. When the person experimented on takes a deep inspiration, we see the arytenoid cartilages and vocal cords widely separated, the cartilaginous rings of the windpipe, &c.; and, if the neck is straightened, we may, in favourable circumstances, obtain a view of the bifurcation of this tube,—*vide* Fig. 2. On making a succession of expiratory efforts, as in laughing, in which case the syllable "ha" is rapidly repeated, the arytenoid cartilages and edges of the vocal cords are suddenly brought into juxtaposition and then separated with equal agility during each intermission.

The action of the larynx during the process of deglutition is interesting, but somewhat difficult to observe. It undergoes a complete closure, so as to prevent the entrance of any alimentary matter.* The changes seen are thus given by Czermak:—1. An intimate apposition of the arytenoid cartilages, and of the true and false vocal cords occurs. 2. The false vocal cords also approach the true cords, so as to obliterate the ventricles of Morgagni. 3. The epiglottis is lowered, its cushion at the same time becoming more and more prominent, until it reaches the fold of mucous membrane which encloses the arytenoid cartilages. Figure 3 represents the commencement of the closure, as seen in the laryngeal mirror. When the larynx is completely closed, we see an image analogous to that of Figure 4, with this difference, however, that in the latter there exists a free space for the passage of air between the epiglottis and the arytenoid cartilages, whilst in the former this space is occupied by the cushion of the epiglottis, and the closure is *hermetic*.

The voice is formed, according to Garcia, "by the compressions

* The conclusions deduced from the experiments of Mons. Guinier, recently brought before the Academy of Sciences of Paris, have been questioned. The view that the food comes into contact with the vocal cords in deglutition was ably refuted by Dr. Gibb at the last annual meeting of the British Association for the Advancement of Science.

and expansions of the air, or the successive and regular explosions which it produces in passing through the glottis." It may be inspiratory or expiratory; the latter, however, will be alone referred to in the following observations. The inferior or true vocal cords *alone* give origin to sounds, the superior or false cords taking no part in the generation of these sounds, whatever their register or intensity may be. When we desire to produce a sound, the arytenoid cartilages approach one another with an astonishing mobility and freedom of action. The vocal cords, thus becoming approximated, assume what is termed "the vocalizing position." In the production of the lower notes, the vocal cords are seen to vibrate throughout their entire length, and, probably, throughout their entire breadth also. As the voice ascends from its lowest to its more acute notes, the lengths of the vibrating portions of the vocal cords are proportionally diminished, their tensions are increased, and the arytenoid cartilages become more closely apposed.

The vocal cords, in fact, present the same phenomena as those of musical cords, and appear to obey the same laws.* It is almost impossible to study the condition of the larynx during the production of the lowest chest sounds, because the arytenoid cartilages, becoming elevated, rapidly approach one another, even to complete contact, and bend themselves under the border of the depressed epiglottis, so that this latter entirely conceals from vision the interior of the larynx,—*vide* Fig. 4. There is, in all probability, however, no considerable difference in the behaviour of the larynx during the emission of the gravest sounds and those less grave. The appearance of the glottis when Do[1] of the chest register is sounded has been represented in Fig. 5. The state of the interior of the larynx during the emission of the most acute sounds is, on the other hand, very readily observed. The glottis is contracted into a linear form, and the various parts of the larynx are felt to be in a state of great tension,—*vide* Fig. 6. Three registers of the expiratory voice are generally described: the chest register, which commences lower in a man's voice than in a woman's; the falsetto register, extending equally in both voices; and the head register, which reaches higher in the female voice.

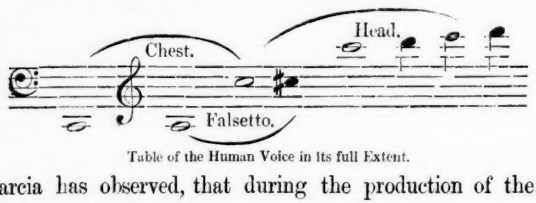


Table of the Human Voice in its full Extent.

Garcia has observed, that during the production of the chest

* *Vide* 'Observations on the Movements of the Larynx when viewed by means of the Laryngoscope,' by J. Bishop, F.R.S., in 'Proceedings of the Royal Society London,' June 5, 1862. Vol. xii.

tones a larger surface of the vocal chords is in a state of vibration than when the falsetto notes are emitted, in which latter case the extreme edge only of the vocal cord vibrates, and a much less expenditure of breath is required.

Great difference of opinion prevails as to the exact mode in which the falsetto notes are produced. Amongst those who have especially studied this subject, the names of Magendie, Mayo, Müller,* and Lehfeldt, Willis, Pétrequin, and Diday, Bishop, Battaille, and Wheatstone may be mentioned.

These registers may be compared with greater facility if thus represented:—

Chest Register.	Falsetto Register.
1. The vocal chords vibrate *throughout their whole extent*, viz., in their subglottic and ventricular regions and on their free border.	1. The vocal cords vibrate only on their free border, and in their ventricular region, *the subglottic region ceasing to take any part* in the generation of sound.
2. Vibrations become *more* rapid and *ample* as the sound becomes more acute; the reverse occurring when the sound becomes more grave.	2. Vibrations become *less ample* and more rapid as the sound becomes more acute: but when more grave, the reverse takes place.
3. Longitudinal tension is *stronger* than in the falsetto register.	3. Longitudinal tension is *feebler* than in chest register.
4. Opening of the glottis is *rectilinear*.	4. Opening of the glottis is more or less *elliptic*.†

If Mi$_3$ of the chest register be produced, and then, without any interruption to the current of air emitted, the experimenter suddenly passes to the same note in the falsetto register, the difference in the appearances reflected in the laryngeal mirror will be found to be very striking,—*vide* Figs. 7 and 8. The existence of a third register has been denied by Müller, Bennati, and Gibb. Garcia very briefly refers to the head register and its relation to the falsetto, laryngoscopically, in his paper already referred to, which is also contained in the under-mentioned pamphlet.‡ Lastly, Battaille writes of the head voice in the following manner:—"L'anatomie et la physiologie repoussent également la dénomination de voix de tête, fort improprement appliquée au registre de fausset." The interesting revelations above disclosed to us by the aid of the laryngoscope alone afford proof of the great value of this instrument, not only to the physiologist, but also to the vocalist. Its great assistance, moreover, to the physician cannot be overestimated; for it is only by the multiplication of such instruments as the ophthalmoscope, the laryngoscope, &c., whereby diseases can be seen by the eye and determined with certainty, that the science of medicine can surely, although perhaps slowly, proceed to that

* The experiments of Professor J. Müller, of Berlin, relative to the production of vocal sounds are extremely interesting. *Vide* 'Ueber Compensation der Phys. Kräfte am Menschlich. Organ.' Berlin, 1839.

† *Vide* 'Nouvelles Recherches sur la Phonation,' par Ch. Battaille. Paris, 1861.

‡ 'Notice sur l'Invention du Laryngoscope,' par Paulin Richard. Paris, 1861.

advanced stage towards the ultimate goal of perfection which is already reached by many of the other sciences.

EXPLANATION OF THE FIGURES.

The anterior portion of the Larynx is represented above, and the posterior part below :—

Fig. 1. Represents the appearance of the larynx during tranquil respiration. The epiglottis is raised, the glottis is widely opened, and a portion of the anterior wall of the windpipe is visible.

Fig. 2. The condition of the larynx during a deep inspiration. The rings of the windpipe, and its bifurcation into the two bronchial tubes, are here apparent.

Fig. 3. Represents the semiclosure of the glottis during the act of swallowing.

Fig. 4. The appearance of the glottis during the production of the gravest chest sounds (after Czermak).

Fig. 5. The appearance on the emission of the chest sound Do^1 (after Battaille).

Fig. 6. The condition of the larynx during the production of the most acute sounds.

Fig. 7. The appearance of the glottis on emitting $Mi\flat^3$ of the chest register.

Fig. 8. The appearance on suddenly passing to $Mi\flat^3$ of the falsetto register (Battaille).

a. The epiglottis.
b. The inferior or true vocal cords.
c. The superior or false vocal cords.
d. The tubercle of the cartilage of Santorini, which rests on the apex of the arytenoid cartilage.
g. The arytenoid cartilages.
h. The ventricles of Morgagni.
l. The anterior wall of the windpipe.
m. Right bronchus.
n. Left bronchus.
o. The posterior wall of the larynx.
p. The aryteno-epiglottic ligament.
r. The posterior wall of the gullet.
s. The entrance of the gullet, the line of demarcation between the wall of the pharynx and the posterior surface of the larynx.
t. The cushion of the epiglottis.
w. The tubercle corresponding to the cartilage of Wrisberg.
z. The base of the tongue.

VI. COMPARATIVE PHILOLOGY AS INDICATING THE ANTIQUITY OF MAN.

By David Parkes, President of the Sheffield Literary and Philosophical Society.

Writers on the Antiquity of Man generally attempt to demonstrate their position by referring to the undoubted remains left by man during ages long past, such as the lake dwellings of Switzerland and other places, rude pottery found in Egypt in the Nile deposits, which have been formed during years to be numbered by tens of thousands, flint implements discovered in the gravel pits of Abbeville, the contents of immense shell mounds, and other débris found in Denmark, the Neanderthal skull, &c., to all of which an

almost incalculable antiquity has been assigned. Such investigations are now open to every one, and the mere reading of Sir Charles Lyell's work on 'The Antiquity of Man,' would be sufficient to convey a general and, in fact, very good idea of the subject. The question has, however, been discussed from these data almost to exhaustion, and on this account I shall form no theory nor draw any conclusions from such data, but proceed by a more original and perhaps equally conclusive mode of reasoning, *viz.* the application of Comparative Philology to this most important subject. This has never been done in detail, though many able writers, such as Sir Chales Lyell and the author of 'Vestiges of the Natural History of Creation,' have illustrated the subject in general terms, but have not entered into those minute details which alone are able to carry conviction to scientific minds. Although the investigation must be attended with difficulties, and the examination of mere words may be uninteresting to many, the subject shall be treated as agreeably as the nature of it will allow, and at the same time as fully as the brief space allotted to such a subject in a journal will admit of.

The comparison of languages is now very generally admitted to be a much more certain method of determining the place of man in Creation than the mere peculiarities of colour and bodily conformation, or any other external circumstances, inasmuch as language is the very embodiment of thought, or the expression of all mental conceptions, and therefore altogether psychological. The author of the 'Vestiges,' the last edition of whose work was published in 1860, says:—"Language is a profound expression of the idiosyncrasy of a people, not easy to be obliterated or disguised. There are upon earth between three and four thousand languages, perhaps for the most part as distinct from each other as French, English, German, but like these exhibiting relationships which at once enable us to decide on the relationships of the nations to which they belong. A relationship amongst languages is shown in the community of words or roots of words. This is the kind of relationship with which we are most familiar; but it is one liable to some obscurity, as it may either happen that all or nearly all traces of a common vocabulary have perished between nations known to be akin, or there may be a community of words that is only the result of accident. By far the most certain test of an affinity between languages is the trace of a common character or analogy in their grammatical structure and in their laws of combination—what has been well called the mechanism of speech. This is both a more immediate and distinct expression of intellect, and one which tends to be more permanent."

The languages of most civilized nations are intimately connected with each other, so as in fact to show *one* centre of creation, although the author just quoted says, that the *six plans* of languages into

which he divides the tongues of the whole human race appear to have originated in entire independence of one another, and are each expressive of the idiosyncrasy of a *distinct* family of mankind. I hope I shall be able in the course of my present investigation fairly to controvert this bold assertion, supported as it is by Renan ('Histoire Générale des Langues Sémitiques') and many other authors of the same school. A later and much better classification is that adopted by Professor Max Müller, who divides all the languages of mankind into three great families—the Aryan, Semitic, and Turanian. The Aryan or Indo-European comprises the Sanskrit and its modern derivatives, also Persian, Greek, Latin, and all the Keltic, Teutonic, and Slavonic languages of ancient and modern Europe. The Semitic family consists of Hebrew, Arabic, Eastern and Western Aramean, commonly called Chaldee and Syriac, and some other languages and dialects which were anciently spoken in Palestine, Phœnicia, Babylonia, Mesopotamia, and Arabia. The Turanian comprises the Chinese and all other languages which still as in past ages remain extensively agglutinative. Max Müller thinks the Aryan and Semitic are the only families of speech deserving to be so called, and a very few of the languages of these two families will, at this time, exclusively engage our attention.

It is a very interesting circumstance that many important facts may be ascertained relative to the state and civilization of man even in pre-historic times, from the existence of certain words in any family of languages. One great fact is, that before the first separation of the Aryan family of mankind which had most probably its original dwelling-place "as far east as the western slopes of the Belurtag and Mustag, near the sources of the Oxus and Yaxartes, the highest elevation of Central Asia," and long before the dawnings of history, civilization had made rapid strides. On this subject Professor Max Müller, who, although a foreigner, expresses himself with all the force, perspicuity, and felicity of style of the very best English authors, says, "It can be proved by the evidence of language that before their separation the Aryans led the life of agricultural nomads, a life such as Tacitus describes that of the ancient Germans. They knew the arts of ploughing, of making roads, of building ships, of weaving and sewing, and of erecting houses: they had counted at least as far as one hundred. They had domesticated the most important animals - the cow, the horse, the sheep, the dog; they were acquainted with the most useful metals, and had recognized the bonds of blood and the bonds of marriage; they followed their leaders and kings, and the distinction between right and wrong was fixed by laws and customs. They were impressed with the idea of a Divine Being, and they invoked it by various names. All this, as I said, can be proved by the evidence of language. We could not find, for instance, the same name for house in Sanskrit,

Greek, Latin, Slavonic, and Celtic, unless houses had been known before the separation of these dialects. In this manner a history of Aryan civilization has been written from the archives of language stretching back to times far beyond the reach of any documentary history."*

The Semitic languages were spoken from the eastern shores of the Mediterranean to the River Tigris, and even beyond that boundary eastward, and from the Caucasian mountains on the north to the Arabian peninsula, extending to the Indian Ocean on the south. Similar interesting circumstances may be predicated of this grand division of the human race to those which Professor Max Müller has elicited respecting the Aryans. Thus, the term for gold is the same in Hebrew, Arabic, Chaldee, and Syriac, and so is that for brass or rather copper. This shows that while the various tribes of the Semitic family were inhabiting the same locality, those metals were known to all; for had the various tribes already separated, all could not possibly have given the same names to those metals. Not so, however, with respect to iron, because the word for iron (*barzel*) is the same in Hebrew, Syriac, and Chaldee, but not in Arabic. Therefore the Arab branch of the family must have separated first from their fellow Semites, and retired to the Arabian peninsula before the discovery of iron. This event evidently occurred during the age of bronze, which had succeeded that of gold, and before the age of iron commenced; the discovery of iron was, however, made by the Semitic race in pre-historic times. During the age of bronze and before the final separation of the various tribes, the Semites, like the Aryans, were agricultural nomads, the words for plough and ploughing being the same in the speech of all, and they not only dwelt in tents, but possessed houses, and had already formed villages and cities many thousands of years before the commencement of the Christian era, and at the latest during the age of bronze. It is impossible to determine when iron became known to the Arab tribes, but the Chaldeans and Hebrew-speaking nations certainly knew it long before them.

The Semitic tongues, though now and for so many ages differing so widely from the Aryan, can be clearly shown to have originated in one common source with them. Many, and in fact most, objects are designated by different words in each of these two great families of languages—thus river in Hebrew is *nahar*, and in Latin *flumen*. These words are widely dissimilar both in sound and appearance; but when we know that the Hebrew *nahar* is derived from the root *nahar, to flow*, and that the Latin is from *fluo*, also *to flow*; that the Spanish *Rio* and the French and Italian equivalents find their root in the Latin *ruo*, Greek *rheo*, to flow; and that this instance is only one of very many, we see that the same idealism

* 'Lectures on the Science of Language.' First Series, p. 245.

and the same mode of reasoning characterized the original speakers of both the Aryan and Semitic languages, and we can draw the inference quite logically that these races of men were, at least, of the same species, though we could not assert, on such principles only, that they had a unity of origin. So in the case of silver. Silver is *keseph* in Hebrew, from *kasaph*, to become pale or white. So, in Sanskrit, silver is counted as white, and called *sveta*. Thus, also, Hebrew *zahav*, *gold*, from *tsahav*, to shine, *tsahov* meaning yellow, as gold in German is so termed, doubtlessly from its yellow colour. *But* if we can show a *community* of words and grammatical forms, or a sufficient number of them, we may justly conclude that the Aryans and Semites were not only of the same species, but of one family, contrary to the hypothesis of those who, like the author of the 'Vestiges of the Natural History of Creation,' maintain various centres of creation and an entire distinction of race amongst the several families constituting the genus *Homo*.

Now it has been estimated that if only *eight* words were found to be identical in two languages, it would be, according to the doctrine of chances, nearly 100,000 to 1 that they were derived in both cases from some parent language, and that, of course, eight such words would furnish evidence of a common origin scarcely short of absolute certainty; but without stringently insisting on this, which is, however, an ingenious calculation, such a multitude of words exist in the Aryan and Semitic languages common to both families, that it becomes impossible to draw any other conclusion than that all those languages, widely as they are now diffused, and much as they differ from each other, originated during the infancy of the human race in one locality. In order to account for the origin of language, Renan supposes all the roots of words to be onomatopoetic; but others, and chiefly Prof. Max Müller, assert that onomatopoeia has furnished only few words in the Aryan languages. In the Semitic tongues, certainly, many words and roots are onomatopoetic, but, in proportion to the whole number of words in that family, they are comparatively few. It appears highly probable that the first words uttered by man were onomatopoetic, and that man who, from the first moment when he became conscious of being, possessed the power to think and organs of speech, affected by the sounds which he heard and by the sight of all the natural objects around him, would at once imitate those sounds by an almost involuntary exertion of his vocal organs, and contemplate those objects with an eye of curiosity and wonder, not devoid of intelligence. His reflective faculties would soon be brought into operation, and he would naturally give vent to his feelings in words which, once uttered, became the representatives of things from that moment through all succeeding time. This seems to be the most reasonable mode of accounting for the origin of language; but,

although volumes might be written on that subject, as it is not the immediate question under discussion, we must again proceed to discuss the phenomena of words; but, as by comparing those which appear to be the same in both Indo-European and Semitic languages, it is our primary object to prove a unity of origin, words clearly onomatopoetic, however numerous, will be scrupulously avoided. Now, in illustration let us commence with the Hebrew roots, *oon* and *een*, which signify negation. This is expressed in many languages by the letter N. So, in Sanskrit, *na, no, an;* Persian, *nah, na;* Zend and Coptic, *an;* Greek, *nē;* Latin, *ne, nemo, non;* German, *nei, nein;* and English, *no*. The Hebrew word *īsh*, man, is certainly primitive, and in Sanskrit is found *isha*, master, and *ishi*, mistress, answering to Hebrew *ishsha*, woman. So *īsh* is often used in the Old Testament Scriptures in order to distinguish a man of influence from *adam*, a common man. Hebrew *aim*, mother, is also a primitive word and, perhaps, onomatopoetic; it appears in the Greek, *mamma, mammē*; Coptic, *man;* German, *mama, amme;* English, *mamma;* and in Arabic the root *amma*, to be a mother, occurs. It is remarkable that the word mother, as Prof. Max Müller observes, "has not only the same root in Sanskrit, Greek, Latin, German, Slavonic, and Celtic, namely, the root *mâ*," this being equivalent to the Arabic *am*, "but likewise the same derivative *tar*, so that there can be no doubt that in the English *mother* we are handling the same word which, in ages commonly called *pre-historic*, but in reality as historical as the days of Homer or the more distant times of the Vedic Rishis, was framed to express the original conception of genetrix;" and I wish to call attention to the fact that, not only in ages so remote, but even from the time when man became a speaking animal, the same root was used and in the same signification.

My object here is to compare such a great number of words common alike to the Indo-European and the Semitic families, as to leave no doubt on the mind of every student of language that, originally, both families were united, or rather sprung from the same origin. Thus, in Hebrew, Chaldee, and Syriac, *ānak* signifies to strangle and to be in anguish; and in Greek we find *ancho* and *ananchē;* in Latin, *angere* and *angustus;* in German, *enge, angst;* and in Sanskrit, *anhus*. Hebrew, *ārag*, to weave, is used of the spider, in Greek called *arachnē, rag*, the primary syllable of the root, having the power of rapid motion and agitation. Hence to be moved hither and thither; and so we find Sanskrit *rag*, to move; Latin, *regere;* and German, *regen*. The Hebrew root *parah*, to bear, is found in many Indo-European languages, as in Sanskrit, *bhri*, to bear; Persian, *bār*, a burden; Armenian, *bieril;* Greek, *pherō;* Latin, *fero* and *porto;* Gothic, *bairan;* English, *to bear;* and old German, *bären*. From the Hebrew root *ānah*, to groan,

is derived the noun *anēha*, sorrow, identical with the Greek *ania*, sorrow. Hebrew, *argāmān*, purple; in Sanskrit, *ragaman*, tinged with a red colour. The Hebrew word for earth is *eretz;* the Chaldee and Syriac, *ar'ah* and *ar'o;* Sanskrit, *dhara*. *Pelevi arta*, whence *terra;* Gothic, *airtha;* German, *Erde*. It must not be forgotten that, according to the recognized laws of language, letters of the same organ are frequently interchanged for each other, as *b*, *p* and *f*, for instance, as well as dentals for sibilants, &c., otherwise, the analogies of words will not be so easily recognized. Thus, in Hebrew, *bārad* means *to scatter*, as *bārād*, hail, and as an adjective it means sprinkled with spots. Syriac, *barduno*, a leopard; Greek, *pardos;* and Latin, *pardus*. Before I proceed farther, I may say that I shall adduce no words in illustration but those found in the oldest Hebrew writings, which I am enabled to do by consulting Fuerst's admirable Hebrew Concordance and the Lexicon of Gesenius, one of the ablest Semitic scholars the world ever saw, and whose works will never cease to be of authority in Hebrew criticism. To proceed, Hebrew, *bāar*, like the Arab. *bār*, means to dig; and in Latin is found *forare;* and in English, *to bore*. Hebrew, *bar*, corn; Arabic, *bor*, wheat; Latin, *far*, whence *farina*. Hebrew, *pārāh*, to be fruitful, and *porah*, fruitful; Persian, *bar*, fruit. Compare also German *frucht* and English *fruit*. Hebrew, *shen*, a tooth; Arabic, *sinn*. With these agree the Sanskrit *danta;* Latin, *dens;* and Gothic, *tunthus;* Fris. *tan*. The Arabic *jins*, genus, has its equivalent in Greek *genos*: Sanskrit, *jati*, from *jan*, to be born; Gothic, *kuni;* Latin, *genus;* Hebrew, *dootz*, contracted from *dantz*, to dance or leap; German, *tanz;* English, *dance*. Again, Hebrew, *dōr* and Arabic, *dār*, to go round and in a circle, also to remain, delay, may be compared with Greek *dēros:* Latin, *durus*, *durare;* and German, *dauern*. Hebrew, *dūchak*, to repel, drive away, finds its equivalent in the Greek *diōkō*. Hebrew and Arabic, *hamar*, to flow in a rapid stream, agreeing with Greek, *ombros*; Latin, *imber*. Hebrew, *zā'am* (Arabic, *ja'am*, to foam at the mouth as a camel), to speak angrily, and as a noun, foam; German, *schaum*, *schaumen;* English, *scum*, and *to skim*. Hebrew, *yāda'*, like the Greek *eidon*, *oida*, to see; hence to perceive, know. "This root," as Gesenius observes, "is very widely extended in the Indo-Germanic languages, in the signification both of seeing and knowing, as Sanskrit, *wid*, *budh;* Zend, *weedem;* Greek, *eidō*, *idō*, *oida*, *daeō;* Latin, *video;* Gothic, *vitan;* German, *weten*, *wissen;* and also in the Slavonic tongues."—*Lex. in loco*. Hebrew, *kad;* Sanskrit, *ghada;* Slavonic, *kad;* Latin, *cadus;* Greek, *kados*, a jar or vessel for wine or water. Hebrew, *kavah*, to burn; Greek, *kaiō*; Old Attic, *kaō*; Sanskrit, *cush*. Hebrew, *koor*, to dig, bore through, and Arabic, *kaur*, a digging in the earth; Sanskrit, *k'hur*, to cleave, dig, and, as a Hebrew noun,

machērah, from piercing; Greek, *machaira*, a dirk or sword. Hebrew, *kalah*, to close, shut up; Greek, *kleiō*, *kleis*; Latin, *clavis*. Hebrew, *kālam*, to wound, and Arabic, *klam*; Sanskrit, *klam*. Hebrew, *kāna*, to bow the knee; Greek, *gonu*; Latin, *genu*; Sanskrit, *ganu*; Gothic, *keniu*; German and English, *knie*, *knee*. Hebrew, *lāat*, *loot*, to wrap round; Sanskrit, *lud*; Greek, *lathō*; Latin, *lateo*. The Hebrew *kol*, voice, from *kol*, to call, is extensively used; Sanskrit, *kal*, to sound; Greek, *kaleō*; English, *to call*. Hebrew, *madad*, to measure; Sanskrit, *ma*, *mad*; Zend, *meete*, *mate*; Greek, *metron*, *medimnos*; Latin, *metior*, *meta*; Gothic, *mitan*; Anglo-Saxon, *metan*; and German, *messen*. Hebrew, *mooth*, to die, appears in all the Semitic languages, and in many of the Indo-European. The middle radical seems to be softened from the liquid *r*, an example of which is found in Hebrew *darash* and *doosh*, so that the original stem would be *mrt*; Sanskrit, *mri*, to die, *mrita*, dead, death—also, *math*, *muth*, *mith*, *meth*, *mid*, *med*, to kill; Malay, *mita*; Zend, *mrete*; Pelev. *murdeh*, *mard*, *mortal*, *man*; Persian, *mardan*, to die; Greek, *mortos*; Latin, *mors*, *mortis*; German, *mord*. To these may be added the New Zealand, *i.e.* Maori, *mate*, to die, cognate, like many other words in the language of New Zealand, with the Malay, and perhaps Sanskrit.

Again, Heb. *mālā*, to fill, Arab. and Syr. idem. This root, like the last, seems to be co-existent with the origin of the two families of languages which we are comparing with each other—*m* being changed for *p* and *f*, in accordance with the law which frequently changes the letters of the same organ for each other, in this case all labials: thus—Sanskrit, *ple*, to fill; Gr. *pleō*, *plērēs*, *bluō*, *brunō*; Lat. *plere*, *plenus*; Goth. *fullyan*; Ger. *füllen voll*; Eng. *full*, *fill*, &c.; Heb. *māsach*, to mix. This root is also widely extended, appearing in Hebrew, Arabic, Chaldee, and Syriac, also in the German *mischmasch*; Sanskrit, *maksh* and *misr*; Gr. *misgō*; Lat. *misceo*; Polish, *mieszam*; Bohem. *smīsseti*; Eng. to *mash* *mix*; Ger. *mischen*. Heb. *mashash*, to feel; Arab. idem.; Gr. *massō*. Heb. *na'ar*, boy, feminine *na'arāh*—no doubt this is a primitive noun, in Sanskrit *nara*, man; *nari* *nare*, woman; Zend, *naere*; Persian, *nar*; Greek, *anēr*. Heb. *naphal*, to fall—the root is the same in Chaldee and Syriac; and the primary syllable, *fal*, appears in the German *fallen*; Eng. *fall*; Gr. *sphallō*; Lat. *fallo*; Sanskrit, *spaladini*. Heb. *saphad*, to beat the breast as a sign of grief; Gr. *sphadazō*. Heb. *'avar*, to pass over; Arab. idem.; and as a noun, *shore*; Ger. *ufer*; Sansk. *upari*; Pers. *aber*; Gr. *huper*, *pera*, *peran*, *peraō*; Latin, *super*; Gothic, *ufar*, *afar*; German, *über*; English, *over*. Hebrew, *'aitz*, a she-goat; Syriac, *'ezo*; Sanskrit, *adsha*, he-goat, *adshá*, a she-goat; Gothic, *gaitsa*; Anglo-Saxon, *gat*; German, *geis*; Greek, *aix*, *aigos*. Hebrew,

gamal, camel. This word, like the last, appears in all the Semitic languages, and very many of the Indo-European, and it is evident from this circumstance that the camel and the goat, as well as the horse, were domesticated before the separation of the Semitic and Aryan peoples. Horse is in Hebrew, *parash;* also Arabic, *fărăs;* German, *pferd*, *d* for *s;* English, *horse*, *h* for *p* and *f*, as in Latin *facere;* Spanish, *hacer*, *h* for *f*. So also Heb. *par*, a young bullock; German, *farr;* Anglo-Saxon, *fear*. Hebrew, *'ĕpher;* Arabic, idem. calf; English, *heifer*. The raven, Hebrew and Arabic, *'orĕv;* Sanskrit, *karawa;* Greek, *koraæ*, evidently received its name during the same period; and here we must include the Hebrew *shōr*, ox; Syriac, *tora;* Greek, *tauros;* Latin, *taurus;* German, *stier;* Gothic, *stiur*. The Arabic and Chaldee agree with the Hebrew and Syriac. Hebrew, *padar*, like the Arabic *fadan*, means to fatten cattle, and appears in the German *futter;* English, *food*, *fodder*, *fat*, *fatten;* Icelandic, *feitr*. The primary root being *fad*, to which *r* is often added, as *pita*, *pater;* *pigeo*, *piger*. The common ancestors of the Aryan and Semitic nations gave the same name to the sun: in Hebrew, *shemesh;* Arabic, *shams;* Syriac, *shemsho*. The word is found under the radical letters *sm*, *sr*, *sn*, *sl*, in very many languages, as in German, *sonne;* English, *sun;* Latin, *sol;* old German, *summe*, whence summer; Sanskrit, *sura*, *surja*. In Hebrew, *rasas* means to moisten or sprinkle, whence *resīsīm*, dew-drops, of such excellent use in irrigating the ground before artificial means were invented, so we find the corresponding terms in Sanskrit, *rasah*, dew; Greek, *ersē;* Latin, *ros*. The sack and the horn were necessary instruments in the earliest days of man's existence, and so we find identical terms for them in most languages; thus, in Hebrew, *keren*, a horn, and so in all the cognate languages; and in Greek, *keras;* Latin, *cornu;* Sanskrit, *cringam;* Gothic, *haurns*, whence English, *horn;* and the word *kāneh*, a reed, seems to be of the like early use; in Greek, *kanna*, *kannē*, *kanē;* and English, *cane*. It occurs in early Hebrew (Jos. c. xvi., v. 8) as the name of a town. It would seem that the first inhabitants of the world were not ignorant of music, *shīr* in Hebrew meaning to sing, and finding its equivalent in the Sanskrit *shŭr*, also to sing; the harp (perhaps the Eolian) being named in Hebrew *kinnor*, finding its root in *kanar*, to give forth a tremulous sound, whence Greek *kinura* and Latin *gingrina*. The Hebrew root *shīth* is found also in Syriac and Chaldee, signifying to put, set, place, &c., and is of very extensive use in the Aryan languages; Sanskrit, *stha;* and in the Greek words *histēmi*, *stoa*, *stēli*, &c.; Latin, *sto*, *statuo*, *statura*, *stabilis*, and scores of other words. It is also found in English, German, and all other Teutonic, as well as in the Neo-Latin tongues; from the Hebrew root is derived *shathoth*, columns, metaphorically applied to princes and nobles; and the Chaldee

shuth, a derivative of the same root, is foundation; and the name Seth is also a derivative, meaning set or appointed instead of another.

The numeral adjectives are commonly and very properly adduced to prove the relationship of languages, and at least five of the ten integers can be shown to be the same in the Aryan and Semitic families of speech. Thus, *echad*, one, in Hebrew and its cognate tongues, has the same radical letters in the Pehlevi, *advek*, and without *daleth* (d), in Sanskrit *eka*, and Pehlevi, *jek*. Heb. *sh'nayim*, two, Arab. *atnan*, Syr. *taren*, Chal. *terain*. The primary form appears to be *tenī*, and this has been softened to *dwi* in Sanskrit; Gothic, *twa*, Greek and Latin, *duo*, and German, *zwei*. Heb. *shalosh*, three, Arab. *thalathah*, Chal. *telath*. The primary form seems to be in the Zend, *teshro*, and transposed from this both Chal. *telath* and Greek, *treis*, Lat. *tres*, Sanskrit, *tri*, one liquid taking the place of another. Heb. *shēsh*, six, of analogous form in other Semitic languages, and in Sansk. *shash*, Zend, *qswas*, Slav. *schest*, Gr. *hex*, Lat. *six*. Heb. *sheva'*, and so both Syr. and Arab., Sansk. *sapta*, Goth. *sibum*, Ger. *sieben*, and Eng. *seven*. It is also probable that *five*, and other numbers in Hebrew and the Aryan languages, were originally the same, but as the analogy is not so evident as in those already adduced, and as five out of the ten numbers are amply sufficient, I shall not trouble the reader with analogies which might tend rather to perplex than to instruct him. There are multitudes of other words in all the parts of speech in the Semitic family which find their equivalents similar both in form and meaning in the Aryan, a fact of which everyone may convince himself by a careful perusal of Gesenius's excellent 'Hebrew Lexicon,' which has furnished most of the examples already quoted; but it would be useless to increase the number of words here, as those already produced are more than sufficient to prove that all the Aryans and Semites once spoke the same language, and consequently, that they did not spring originally from different centres of creation, but rather constituted a single family, originating in one locality. It would be interesting now to inquire whether the numerous dialects of Asia, Africa, the Polynesian Islands, and the aboriginal tribes of America would bear the same test, and thus prove that all men are members of one family—the descendants of one parent; but this task must be deferred, as it has no connection with the problem now under consideration. I presume, however, that it can no longer be doubted that the Aryan and Semitic peoples sprung from one stock, and in order to account for the great varieties in their several languages, it is necessary to suppose that a separation of the two great families or divisions happened in a very early period of the existence of mankind, and that then the languages of both families grew gradually and expanded, without having any material connection with each other, from some

original tongue consisting of a very limited vocabulary, and few or no grammatical inflexions.

What an immense number of ages must have revolved in their ceaseless progress in order to develop this mere skeleton into such a fine body of language as we have evidence that Sanskrit on the one hand, and Hebrew or Arabic on the other, had assumed more than three thousand years ago. It is a fact capable of demonstration, that in this remote period there existed as much dissimilarity between the two families as at the present time, both as to their vocabulary and grammar; that is, there was no closer resemblance between Hebrew and Sanskrit than there is between Arabic and Greek at this day, after the lapse of three or four thousand years. Nevertheless, the mutations in all these languages have been exceedingly slow; Arabic, for instance, having scarcely yet arrived at that state of analytic decay at which Hebrew had arrived in the days of Moses; and yet when Hebrew was a living language it sustained scarcely a dialectical change during the period of a thousand years; and when we consider that Sanskrit and Hebrew must have gradually developed themselves from mere roots into the magnificent trees to which they may fitly be compared, and that thousands of years have been insufficient to produce any radical change in them, what an incalculable number of ages must have elapsed since they first began to grow, gradually advancing to synthetic maturity, and then as gradually decaying in structure, till we find their living representatives as Greek and Arabic, although much changed, still retaining all the more remarkable characteristics of their cognate tongues.

There is no reason why I should confine myself to Hebrew and Sanskrit for illustration, except for the sake of brevity, for the same phenomena are observable in Greek and other languages which have come down to our own times. Indeed, it is well known that Greek has retained the great majority of its ancient words and much of its synthetic character to this day. The spoken language has of course assumed a more analytical form, but it has undergone so little *radical* change, that Thucydides, for instance, would find no difficulty in reading Tricoupe's 'History of the Greek Revolution:' in fact, the two authors have been compared with each other as to style and language. The changes, then, which Greek has experienced have been very gradual, like those of Hebrew and Arabic, and the same may be predicated of many other languages.

And now, if we should illustrate the matter by a diagram, the best form would be an acute angle, the extreme points of whose two sides are very distant, one point representing the Aryan family of languages, and the other the Semitic; and although the extreme points of the two sides might be thousands of miles asunder, the angle itself would be something like the angle of parallax of a fixed star.

The problem would then be to calculate the length of the sides which represent the ages elapsed since the two families set out at the angular point in their progress down the two sides till they arrived at their present position at the end of each line. This line reduced to time I have no hesitation in affirming would represent not only thousands but tens of thousands of years.

VII. ON CELL LIFE.

By Dr. A. Fick, Professor of Physiology and Zoology, Zurich University.*

Plato, the profoundest thinker of the ancients, has already compared the State with a human organism. The several organs of the body represented, according to his ideas, the different vocations of the citizens.

Such conceptions, however fanciful they may seem, have nevertheless invariably tended to advance politics; and again at the present time, the renowned lawyer Bluntschli is endeavouring means to secure for his system profounder deductions and reasoning.

The comparison is really something more than a mere play of fancy, but it is better to illustrate the existence of the animal body by the State, than the existence of the State by the animal body. The points touched upon in the comparison are sufficiently apparent in the State, but in the animal body they are to a great extent concealed. The comparison, too, is a more fruitful one for the physiologist than for the politician. This will be seen from the following remarks, whose aim is to render apparent some of the fundamental relations of the animal economy by means of the simile of the State.

We do not assert that the State is comparable with an animal body; but the converse, the body of one of the higher animals is comparable to a governed nation. If this expression has any real significance, it involves the supposition that the body of the higher animals is made up of individuals, which, like the individual persons of a nation ruled by the State, are in some respects entirely and essentially alike. This supposition has at first something so strange and startling in it, that I must at the outset seek to render it more familiar to my readers.

What then can be these perfect individuals in the animal body? The answer to this is easy: They are the cells.

In order to show at once that I do not stand alone in this view,

* Translated from the German by E. Ray Lankester.

I would remind the reader of the opinion of a well-known labourer in the minute structure of the tissues, Professor Frey, of Zurich, who says of cells, in his 'Handbook of Microscopic Anatomy,' "they represent living beings, both as regards their anatomical and physiological individuality." But what is a cell? To this question it is by no means easy to give a reply. A full and clear definition of a cell is not yet possible. Let us try, by the help of observation and dissection, to form an idea of the nature of a cell. It is well known that the organs of animals and of plants do not consist of a homogeneous mass, but are formed of separate parts which have definite forms and properties. The elementary components of one of the higher animals or plants are various in their character, as the microscope teaches us. Many tissues consist of solid filaments, others of pipes or tubes, which are filled with contents readily distinguishable from the tube-walls. These elementary parts may exhibit, in their fully developed condition, great variety and differences, but in the earliest stages of development they are not distinguishable from one another.

Where a tissue is about to be developed, a number of small bodies are observable from the commencement, always wonderfully alike in form. They appear to be rounded lumps of a thick slimy substance; somewhere in the inside of each lump there is a clear, well-defined, and somewhat transparent globule, with a dark spot in the middle. Such a body as this is called, in the restricted meaning of the word, 'a cell;' the transparent globule within it, 'a nucleus;' and the dark spot in the middle of the globule, 'the nucleolus.' The formation of the most complex tissues of the animal body takes place in the following manner only: The original component cells multiply themselves. This multiplication takes place (as far as sound observations have ascertained) entirely by the subdivision of the mother cells, a process which is continually going on; the nuclei divide so as to separate the nucleoli into halves, and the surrounding material draws itself together into two masses around each of the newly-formed nuclei, and at last the masses become detached from one another.

Connected with the preceding statement, there is a most important question, relating to our knowledge of organic nature, in regard to which a lively contest has lately been renewed. The question is, whether individual creations of organic beings occur. Here the problem comes before us in a still more general form—namely, are there special creations of cells. The most reliable observers at the present day are agreed that the creation of a cell in an animal tissue has never yet been seen with certainty, and that each cell is the offspring of another, from which it has separated by division. Here, then, we have already decided evidence that the cell is to be regarded as an organic individual.

In the development of a tissue, the newly-formed cells increase by subdivision. They grow, according to the character of the tissue, into various forms, and in most cases secrete the materials which they have elaborated within their walls. Generally they become compacted together on the surface, and in many tissues in a fully-developed condition they constitute the chief mass of the whole tissue. Always, however, as long as the tissue is living, there must still remain those bodies, which are cells in the true sense of the word—the little lumps of that mysterious gelatinous matter which has in recent times been called Protoplasm. It is probably within this substance that the final problem of organic life lies concealed. Its peculiarity does not consist in its shape, but in the substance itself; for wherever it is, in whatever form it may occur, *there* we have manifestations of organic life. The *chemical* and *physical* properties of this protoplasm, as far as we at present know, are to a great extent passive (probably it is a compound of different chemical bodies, among which albuminous or white-of-egg-like substances are the most prominent); all the more remarkable therefore, are its *physiological* actions. Above all, it is important to keep this fact in mind, that wherever a separate piece of this substance is found growing and developing, it is (in accordance with the nature of the procreation of cells described above) a portion separated from another protoplasmic mass; in no case, so far as reliable observations have extended, is it ever spontaneously developed from its constituents.

But what is it that gives us a right to the paradoxical supposition that each protoplasmic lump, individualized by its central globule or nucleus—each cell, in the animal body—is a separate animal *subject*, with individual animation? In fact, I ascribe to each cell, not only of the animal, but also of the vegetable body, *animation* in the truest meaning of the word. To express my view as clearly as the obscure nature of the subject will admit, I am of the persuasion that this thing which *objectively* appears to us as a microscopic, minute lump or knot of gelatinous matter, is in itself, *subjectively*, a thing, similar to our own personal self; a thing conscious of the influence of other things (*sensative*), and of its own influence on other things (*volitional*).

I cannot but feel certain that such a stretch of the idea as this will be received by most persons simply with an elevation of the eyebrows and a shake of the head. Materialistic views of the world, at the present day, exercise a very widely-spread dominion, even in the minds of men who are, in fact, continually repudiating the ultimate consequences of materialism. The materialist's view of the world is simply an instance of one-sidedness, since it is a concession of existence to those things only which are *objectively* apparent—which are regarded by him merely as passive masses of

matter in the network of causes. Those who view the world from a materialistic aspect assume the right to deny that the things which are yet beyond our experience possess in themselves an existence as *subjects*. I will stop no longer to criticize this view of the world, nor will I further delay the continuation of my observations. I hope, also, without having placed the matter in the position of a certainty, that the reader will at least allow that an organic cell has a true subjective existence. One cannot with certainty prove the truth of this hypothesis; and indeed, at present, it must remain a supposition, because the inner being of the thing itself is not open to our experience. In the same manner, we cannot certainly prove the animation of another man. In point of fact, as a mere matter of experience, a man is nothing more than one of the numerous phenomena of our *objective* experience; that is to say, a something from which material influence on other matter proceeds, and which is obedient to the great network of causes. Nevertheless, it has not yet occurred to any reasonable man to deny the animation of another.

But what is it that makes us acknowledge the animation of another man, seeing that there is no direct experience about it? It is the following conclusion, derived from analogy, which makes us certain of it. The individual Self is not only subjective, but as a corporeal phenomenon it is also objective with regard to the sensitive perceptions. We see our hands and feet, we hear our own voice, and distinguish it from that of another person's; as also we see the limbs of other men, hear their voices, and so on. In the range of our experience, we find the deportment of another man exactly like the deportment of our own body, as far as it is objective to us; and hereon we found the certainly just analogical argument, "Because I and another man exhibit exactly the same deportment *objectively*, so do we agree *subjectively;* and because I inwardly know myself to be an animated being, so the other man also will be a similarly animated being."

Only once let us tread this path of analogy, and we shall find, as will be seen, that we can find no conclusion to the range of life but in the simplest cells. In fact, that one cannot stop at man is clear enough, and generally acknowledged. The higher animals, and especially those nearly related to us, are so much like us that it would be foolish to deny their animation. No one would be surprised at our ascribing animation, or understanding, or even reflection, to a dog or an ape; but if we descend lower in the catalogue of animals, the signs of mental or spiritual life become naturally less and less visible, yet the degradation is so gradual, that we are unable to stop at any point in the list, and say, "Here animation ceases and the simple machine begins."

If we once ascribe animation to an ape, we must allow a polyp

or an infusorium to be an animated being. Of course no reasonable man will overlook the enormous difference in the degree of animation in different animals. No one will suppose for a moment that any infusorium can form a clear idea of the objects in the world around it. To this faculty belong certain complex apparatuses, which the infusoria do not possess. The clearness of their consciousness certainly does not even nearly attain to the clearness of our consciousness when in the deepest sleep; but as there is a regular and gradual transition between sleeping and waking, so is there between the degrees of animation in different creatures. The comprehension of spiritual matters, the amount of consciousness, the lucidity of the ideas produced by objects in the external world, vary interminably; but the essence of the thing remains the same, even in the very lowest grades of the organic kingdom. There is, in every case, a feeling of self-separateness or individuality, distinct from the outside world; the active influence of that world is felt, and upon it the *subject* desires to direct its influence.

There is no doubt that this proposition is clear enough to all who rank themselves as disciples of Darwin as regards the origin of species. For this philosopher surrounds, as did the ancient religion of the Indians, the whole organic world with the bands of brotherhood. I have, however, purposely avoided grounding my argument on the doctrine of that teacher, because it cannot yet be held as a proved scientific truth. So, then, if it be once admitted that animation extends downwards into the lowest forms of the animal kingdom, then it is also admitted that *there exist single cells, which are to be reckoned individually as animated beings;* for there are numberless animals belonging to the order infusoria which consist of a single cell. Such an animal, for instance, is an Amœba, a minute, microscopic, protoplasmic mass, with nucleus and nucleolus. If its actions are observed under the microscope, one can see how it alters the form of its body at will; how it sends forward prolongations here and there, draws out the mass of its body, and so changes its place. On outward irritation, it generally rolls itself up into a bullet-shaped lump, and rapidly draws in again all the prolongations lately stretched forward. Often one may observe it engulf smaller bodies in its substance, where they are changed—one may say, digested—and half disappear, the undigested leavings being again ejected. The little animal grows, and goes on propagating itself by division.

A cell which belongs to the tissues of one of the higher animals behaves exactly in the same manner as a single-celled infusorium. For example, in the blood we have cells; the so-called white blood corpuscles, which are exactly like certain infusoria. Thus they stretch out prolongations of their substance subject to their will, and upon irritation and the like they show the well-known reactions. The cells

in connective tissue deport themselves similarly. They crawl regularly about in certain chasms in the substance of the tissue formed beforehand, which they elaborated for themselves, which, in fact, they have constructed as their dwelling. What is particularly worthy of attention is, that these cells when they have left the tissue, can move themselves for some time in a fluid, and show all the phenomena described. These facts are truly among the most beautiful acquisitions to our knowledge lately derived from microscopic research. They had for a long time escaped the attention of microscopic observers, because animal tissues were not examined under the same condition in which they exist in the living organism. It has already been mentioned that cells in the tissues of highly organized animals are exactly the same in their growth and reproduction as single-celled organisms. And, in the last place, to complete the identity, all the cells of a whole animal are actually the brood of one single cell—namely, the ovum. We have here before us exactly the phenomena which we regard as the characteristics of an animated being—movement at will, and reaction on outward irritation. Thus, then, we can by a well-connected chain of strict analogies arrive at the proposition which was placed before us. Each cell, whether it be an independent animal or part of the tissues of a higher organism, is in itself. *subjectively*, an animated being. The want of self-dependence in the cell, which forms a part of the tissues of a higher animal, is really not greater than in the single-celled infusorium, which lives freely by itself. In fact, each organism has its own conditions of life; and as the tissue-cells can only live, for any length of time, in a certain fluid, or in their appointed self-wrought habitation, where they dwell as a compound organism, so can certain single-celled infusoria live persistently only in certain fluids; they also die if placed under conditions to which their organization is not adapted. I am not, moreover, at all certain, as before said, of the impossibility of a cell, if once removed from the blood or connective tissue of a higher animal and placed in another soil (as it were) under favourable auspices, proceeding with its life as an independent animal, and becoming the mother of a brood of infusoria.

From the standing-point which we have now gained, we cannot call an organism which consists of more than one cell an individual. Such an object is much more like an association of individuals, which live together in a habitation wrought by them. The cells have themselves secreted the materials for building from their bodies. Association makes a division of labour possible. It is no longer necessary for each cell to execute for itself every organic function—digestion, assimilation, &c., in their different stages. One group is able much more satisfactorily to execute this, and another that office for the whole household; and thus the particular functions

are brought to greater perfection, and the performances of the entire organism become more varied and numerous.

The best type of such an association of organic individuals is a plant. Here we see different groups of cells execute different offices which benefit the whole plant. One set extracts material from the ground, another elaborates it in various ways; others again draw material from the air; others are especially fruitful in producing new generations. But we do not attain to the higher efforts of physical activity in the plant. The reason of this is easily seen.

In plants, each single cell surrounds itself directly with a membrane of the so-called cellulose, the substance which we have before us in wood, in cotton, and in paper. The cells are, by means of this, individually shut up; they can, it is true, influence one another to a certain degree, in that they can transmit material to one another; but they cannot influence one another to an unlimited extent; they cannot share their conditions, their sensations, we may even say their experiences, with one another. Each therefore is confined to the bare circle of its own sensations (which we are as little able to dispute in plant-cells as in animal-cells), and therefore it can reach to no higher grade of psychical life.

The cells of a plant are, in a word, like a number of men shut up from childhood together in a cellular prison, who perhaps might have exercised much important influence on one another, but between whom all spiritual intercourse has been prevented. These men would never display the deeper characteristics of spiritual development.

In the higher animals there are numerous groups of cells which are disposed in a manner analogous to that observed in the plant cells; that is to say, they lie isolated, yet near each other, though not enclosed in the same hard dwellings as in plants. Such aggregates of cells, for example, are the blood and the epithelium. The epithelium is the name given to the layers of cells which lie arranged like strata wherever an organic structure is bounded towards external space, as in the outer skin (epidermis), and the slime-skin or mucous membrane which lines the surface of internal cavities open to external space. Many other tissues also form the same kind of cell-masses, upon the principle of the plant's organization. Their action has been long designated as 'vegetative,' correctly referring to the analogies which they present to plant-life.

In the higher animals a new system of cells is added to this vegetative group, which are disposed on a totally different plan. It defines what is truly *animal*, and its actions are rightly designated 'animal.'

In fact, the difference between plants and animals does not really lie in their elementary components. Both kingdoms are, as we saw, and as most observers in both now admit, constructed

from elements of a similar nature—from cells. Among the simplest organisms, philosophers have been in much doubt in which of the two kingdoms they shall place those beings consisting of but one or few cells, and perhaps there is nothing to justify the assertion of a sharp boundary. The distinction can only be clearly shown where one has to deal with complex organisms formed of many cells. The true characteristics of the two kingdoms are to be found in the manner in which the colony is built up by its individuals, and thus especially in that system of cells just mentioned which gives its peculiarity to the animal kingdom. This system is a series of cells widely spread through the whole body, in which the protoplasmic matter is maintained in unbroken continuity throughout, by fine, long threads. It is the 'nervous system.' Let us consider this wonderful structure somewhat more closely, and indeed let us bring it before us in that form which it takes in man, the highest of now known animals. The cells of the human nervous system are generally packed together in more or less numerous groups, which are called nerve-knots or ganglia, whence the name ganglion-cell is derived for the cells of the nervous system: they are simply, as all cells are, nothing more than protoplasmic lumps with nucleus and nucleolus. The nervous ganglia lie distributed over the whole body, in some places sparingly, in others profusely, and are bound together with connecting cords of the protoplasmic thread, which, as was said, always brings two cells into conjunction. Each such protoplasmic thread is encased in a true sheath, and forms with it what is called 'a nerve-filament.' It must further be noticed that each cell commonly is connected, not only with one, but often with many other cells by means of nerve-filaments.

Besides these filaments, which establish the communication of the nerve-cells among one another, there are others which communicate at one end only with a cell, and at the other end are connected with structures of a different nature. There are two sorts of these filaments, differing very much in kind, though not in their essential nature. The one set—in the strictest meaning of the word—proceeds outwards from the organs of sense, and is destined to convey external impressions to the nervous system. The others, which terminate in the muscular fibres, are appropriated to carrying the active influence of the nervous system to the exterior.

We have now a complete picture of the nervous system in man, when we add that in him, as well as in the four higher classes of animals, by far the greatest number of the nervous elements—that is, of nerve-cells and connecting filaments—are packed together in a continuous mass, and shut up in the canal of the backbone and those cavities of the skull which are continuous with it. These great nervous masses are known as the brain and spinal-cord.

The construction of the nervous system makes it very clear that something takes place here which differs from what occurs in the plant or plant-like tissues of the animal. The nerve-cells cannot only work externally, and operate on one another, by modifying the fluid in which they are placed; they can work upon one another much more directly by means of their connecting filaments of protoplasm; they can mutually communicate their conditions, which as material appearances are called conditions of irritation, but which from their own stand-point are sensations or acts of the will. Here, too, the means are provided to enable a cell (that is to say, an organic subject) to be sensible, not only of that which operates on itself alone, but also of that which affects a thousand other cells continuously connected with it. Thus a cell can learn (if the expression is not too strange) by the experiences of others. Through this it becomes possible for the conditions of animation to attain to that high perfection, in virtue of which the consciousness awakens to that clearness which we experience in ourselves.

The comparison of our body with a State is now no longer a difficult matter. The cells of the vegetative functions constitute a race as it were of mentally-stunted people, among whom each man lives shut up by himself, without knowing much of his neighbour. The epithelial cells of the intestines we may more particularly compare to the agricultural classes, who derive nourishment for themselves and for others from the ground. They give this raw material to the blood-cells, which represent the mercantile classes. These disperse it over the whole State, but are certainly bad tradesmen in the common view of such matters, since they exchange their valuable commodities for nothing but used-up rubbish, which they must dispose of as quickly as possible to the appropriate organs, the lungs and kidneys.

This laborious population bears the yoke of an aristocracy, and submits to be governed by it. I mean the nervous system. There is within this aristocracy a strict system of caste, or I might perhaps better say, a bureaucratic classification. It has also to maintain a standing army in the muscular fibres, and must hold it ever ready for action, for our State is never at peace, and indeed must continually be fighting with other States, and with the forces of nature in the doubtful battle of our existence. The highest place in our aristocracy is not held by a monarch, but by a body of equals. They are the ganglion-cells of the great cerebral hemispheres which so largely constitute the upper part of the nervous system. Here all the filaments meet, here all intelligence arrives at last, and hence proceed the most important decrees to the whole nation. But it must not be supposed that all the sentient filaments of the more highly sensitive organs, of the skin and so on, pass directly to the cells of the great hemispheres of the brain, and that the motor

nerve-threads go without interruption hence to the muscles. On the contrary, there are placed between the periphery and the great cerebral hemispheres, as mentioned already, a lower authority of the bureaucratic mechanism. This is the accumulation of ganglion-cells in the spinal-cord and mid-brain. Especially in this last part of the nervous system, and in the so-called 'medulla oblongata,' in the places where the great nerves of sensation flow in, there are masses of cells representing the highest executive officials. Here the raw materials of sensation are arranged. Here the scraps of news out of the various provinces of the kingdom—that is to say, the sensations from the various authorities on feeling—are brought together and are worked up into abstract conceptions, which are then delivered to the higher body corporate. This finally determines what is to be done in consequence. If a resolution is here carried by a majority, these powers immediately give directions to the subordinates, without entering into details. The resolution is merely a sign addressed to the lower authorities, who then elaborate the details of action and operate upon the nerves distributed to the muscles. For example, a determination is made when in great pain to pronounce a certain word: to effect this, a complex series of movements are necessary, for which purpose a certain number of muscles are disposed consecutively. There must therefore be a number of motor impulses sent from the brain along various lines of nerves; but these motor impulses do not proceed as such from the great cerebral hemispheres, where the resolution is first made. From thence only a simple sign is given, which is at once understood by the wonderfully trained subordinates. These officials are the groups of cells in the medulla oblongata, from them arise the motor nerves of the respiratory apparatus and of the tongue. Here the mandate, indicated by a sign, becomes methodized into various single orders, and now the winged messages go here and there along the various motor lines, conveying the fiats of authority.

The inferior authorities of our bureaucratic mechanism rejoice in the possession of a certain amount of independence. For example, there is that group of cells which is related to the mechanism of respiration. They are continually sensible of the necessity of ventilation for the blood, and thereupon determine to set the bellows in action, more or less quickly, according to the requirement. Most probably the brain receives information of these proceedings, because threads pass from the said cells to it. It can even take an active part in them, since we could form the determination in our central consciousness to arrest the breathing. The servants, however, would not attend to such a selfish command on the part of the supreme power.

The subordinate powers can also act independently upon external impulses. Let us take the effect of ammonia on the

mucus of the nose. The cells in the medulla oblongata feel it, and command the subservient muscles of the thoracic cavity to throw off the irritant by a violent expiration, an act which we generally call sneezing. Such actions, which can take place without the intervention of the superior hemispheres of the brain, have been called 'reflex actions,' as distinguished from actions of the will.

Reflex action is best studied when the cerebral hemispheres have been entirely removed. In some animals this is quite possible without destroying those parts which enable them to move under the influence of external irritation, but the movements then executed are observed to differ from those which occur upon similar irritation when the cerebral hemispheres have not been removed. The various phenomena which have been observed in the actions of animals under these conditions, prove that the spinal-cord is a centre of animation, and the objections of many philosophers against its animation might just as well be urged against that of the brain, if they were in reality valid objections. They say that each of these phenomena can be explained as simple mechanical actions, but *we* are certain that things have an existence independent of our experience, and that this existence in organic individuals is sensation, will—in fact, animation.

Let us now look at the matter from this point of view, which is not the one generally adopted in natural science, but which the interpreter of nature may well accept at once, when he has laid down his dissecting knife. Thus we shall obtain a new signification for some of the phenomena referred to. An uninjured animal—a frog, for instance—makes a spring upon irritation of the skin, because in the cells of the great brain, consequent upon the experiences of the skin and also those of the eye, which are subject to the brain, a supposition is founded that a spring protects the animal from threatened danger; but, on the contrary, if the cerebral hemispheres have been destroyed, the cells of the spinal-cord have to take the lead, and because they have not so much material of knowledge at their command, seeing that they can derive no information from the higher organs of perception, they are unable to form the determination and carry it out, of making a trial of flight. They are only able to give the order to the nearest agent at hand to remove the irritation. This is the foot of the animal, which is accordingly raised to the place subjected to irritation, for the purpose of removing its cause. Thus, then, the subordinate centres of the great cerebro-spinal system become perfectly independent if the superior centres are destroyed. In the course of normal life, they have, on the other hand, as has been already stated, only a relative independence, their commands are only executed when counter-mandates are not issued by the higher centres.

In the ordinary course of life a much greater independence apper-

tains to those subordinate nervous centres which lie scattered over the body, and are placed as guardians of the vegetative activity, such, for example, as the nervous ganglia of the heart and intestinal canal. It is only occasionally, under very exceptional circumstances, that painful news reaches the higher regions from these quarters; it is only in illness, or when an unusual storm of sensation is raging, such as fever, anxiety, and other passions, that any influence from above operates on the beating of the heart. It is worthy of notice that among the connecting threads which contribute to the weak dominion of the brain over the nervous centres of vegetative life, are particular cords which have the exclusive function of conveying counter-mandates against action. These are the so-called nerves of interception. These are capable of conveying such an irritation as to bring the heart to a stand-still.

Among the inferior nervous centres a division of the work into departments occurs, as has been shown by examples. One mass has to elaborate the sensations produced by light into vivid representations; another has to connect these with the sensation of touch; again, another has to do with speech; others arrange the movements of the various extremities; others the throbbings of the heart, and so on. Nothing decidedly analogous to this takes place in the supreme governing body—the cell-mass of the great cerebral hemispheres. Here every cell can participate in every opportunity which is afforded for the activity of the general cerebrum. Each part of this organ, larger or smaller, can set the other parts into action, especially since there is a definite relation between one great half of the brain and the other. These are positive facts which cannot be doubted. In fact, there are numerous pathological observations which show that though men have frequently, either by external injury or destructive disease, been robbed of the greater part of their cerebral hemispheres, yet it has never been remarked in such individuals that any mental power, such as speech or memory, according to the locality of the wound, had been lost. A man, with the greater part of his cerebrum destroyed, rejoices in the same clearness of consciousness and understanding as before. These observations alone would be enough to upset the idle speculations of "phrenologists," were that consummation not already attained by their unreasonable classification of the so-called "mental properties."*

The facts in question enable us to add one more observation worthy of notice. They show that the acuteness of the understanding, and generally the quality of mental power, does not depend upon the quantity of brain, which, however, is a view widely accepted. Nevertheless, the *energy* and *unweariedness* of mental activity seems to depend upon the mass of the brain. In our way

* "Seelenvermögen."

of looking at the question, it must be so, as a matter of course, since when only a small number of cells are at hand, each single cell must be more strained than when many are present to relieve one another. In the first case, the whole mass would speedily become exhausted.

Thus it is, that we find it an acknowledged fact, that the greatest men as a rule have very big heads. It is explained by the consideration that to illustrious actions belong not only activity, but also steady energy and endurance in their accomplishment, which qualities simply depend on the size of the cerebral mass. In the course of our observations, I must freely admit, in conclusion, we passed over an obscure point—namely, How is it that to us our own consciousness seems personal, whereas, according to the representations made above, it should be rather the united consciousness of a people? I know no solution of this problem, excepting a masterpiece of human wisdom from Kant's 'Critique on Pure Reason.' It is this:

"An elastic ball which strikes another divides with it its whole momentum, consequently, its whole phase of being. Suppose, then, an analogous case, in which bodies of like material are concerned, the one imparting to the other *ideas:* a whole series is easily conceived, in which any one which may be regarded as the first communicates to a second its conditions and the consciousness of them; the second acts similarly on a third, communicating, not only its own conditions, but those of the first also; whilst the third in like manner communicates the conditions of all the preceding ones together with its own, and their consciousness. The last body would thus be conscious of all the phases of being of the bodies that had been modified before it, as well as of its own, because these phases of being were transferred to it together with their consciousness, and in consequence of this, would it not have been identically the same individual in all these phases of existence?"*

Is it not as though the great thinker had flashed forth the then undiscovered construction of the nervous system, with its *cells sharing with one another their conditions.* Verily, the veil is as yet but just touched. It still remains impenetrably thick over the secret depths of our inner selves, and so will remain to the end.

* The utterances of great thinkers are ever suggestive. If we have a row of elastic balls touching one another, and give a blow to the first, it will impart its momentum to the second; that will affect the third, and so on, with gradually-diminishing intensity, until the last is impelled slightly forward from the rest. But modern physics teach us that each ball will have been affected in another way. If the force, the motive impulse, has diminished in its passage through the balls, a little heat will have been set up, in conformity with the law of the Conservation of forces.

Thus, when the divine truth or energy is conveyed into the mind of a man who stands at the head of a series of thinkers, it fires his brain; but he imparts the "momentum" to his neighbour, and the influence passes from mind to mind, probably with diminishing vigour, until it reaches the last mind—that which offers the least resistance; for there is none lower to whom it can communicate it; and so *it* is not fired, but moved a little forwards: that last mind is the mind of the masses.—Editors

CHRONICLES OF SCIENCE.

I. AGRICULTURE.

THE CATTLE PLAGUE.—This has continued the overwhelming interest of the past quarter in the agricultural world. Advancing for many weeks at a very rapidly increasing rate, and having attained a fatality of about 1,500 cases daily, it has latterly been stationary; and we hope it is at length feeling the influence of the means which have been employed for its prevention and restriction. The Cattle Plague Act requires the immediate slaughter of affected animals, and permits the local authorities to destroy those which, having been in contact with the plague, may be supposed to have become infected. The rapid breeding and spread of the poison are thus at length in some measure stopped; and we may hope with some confidence that the hitherto rapid extension of the plague has been checked. Every other method than the pole-axe for this purpose has hitherto been a failure. Vaccination, on which some hope had been built, was found to be no security whatever: and every published cure has hitherto, on sufficient test being applied, proved to be fallacious. Acids, alkalies, and salts have all been fairly tried, and all found wanting. Sulphuric acid, sulphates, and sulphites, hydrochloric acid, common salt, lime, salts of iron, sulphur, and a variety of drugs have all proved ineffectual. Mr. Worms, a coffee planter of Ceylon, who imagined the disease to be the same as he had often treated successfully in that island, confidently recommended onions and assafœtida in certain doses as a cure; and it has been largely tried, but without success. Baron Rothschild's herd at Mentmore was rapidly succumbing to the plague, notwithstanding Mr. Worms' treatment, when the experiment was at length cut short by the intervention of the law for slaughtering affected animals. Homœopathic treatment seems, according to the published tables, to have achieved a larger proportion of success than any other. But everybody knows the extreme untrustworthiness of any general conclusion on this subject built upon an insufficient basis of examples. Meanwhile, the fatality of the disease, which, on its first appearance, was extreme, and is still extraordinary, has been gradually diminishing. The recovery rate, which was only 5 per cent. in October, and 6 per cent. in November, over the whole number of cases reported since the beginning, had risen to 11 per cent. in the third week in January, and stood at 12·146 per cent. on February 3, 12·364 per cent. on February 10, 12·680 per cent.

on February 17, 13,377 per cent. on February 24, and 13·956 per cent. on March 3. Since then the slaughter of all affected animals by law has, of course, hindered any further observation; but the plague was apparently obeying the law of other extraordinary epidemics, and gradually losing with extension the extremely fatal type which it exhibited at first. The above are the results of comparing, not one week with another, but the totals since the commencement of the attack up to the end of each successive week. The advance is very much greater if the experience of each successive week be examined by itself. The recoveries, which were only 848, or 4·8 per cent., at a time when there had already been 17,673 cases of the disease in the country, amounted to no fewer than 2,561, or 25 per cent., during a single week in February, when 10,167 fresh cases occurred. We may, therefore, declare that, great as this burden on British agriculture undoubtedly is, some hopeful signs connected with it are at length appearing.

It is, however, certain that they depend very much upon the great fear which the disease has created, and the extreme care now taken in isolating diseased herds. In a lecture by Professor Simonds, before the Royal Agricultural Society of England, the greatest emphasis was laid on the need of this carefulness, as the only hope of preventing the extension of the malady. Labourers, travellers, dogs, cats, pigeons, even the wind, when the disease is general over a considerable area, can carry the poison; and if a particle of the morbific matter gains a lodgment in the system of a healthy animal, it will develop there. Hence, wherever the disease exists, it is of the greatest importance that we detect it early, not merely because the only chance of successful treatment depends on commencing with it at the outset of the attack, but also because the establishment of a complete isolation of the animal, before it has begun to exhale the developed poison, is absolutely necessary. Professor Gamgee's researches prove that the symptom which precedes all others is a slight exaltation of the temperature of the body. A thermometer inserted into the rectum or vagina indicates a temperature of from 2° to 5° Fahr. above the normal 100° in a day or two after the inoculation of the animal with the poison, and some days before the characteristic outward symptoms show themselves. And the examination of whole herds has proved that the natural development of the disease is indicated in the same manner. The misfortune, however, is, that this premonitory symptom is true of other diseases also, so that all that any stock-owner can declare with certainty, on finding that the internal temperature of his beast, ascertained in this way, stands at 103° to 105°, is that its health is disturbed. If he fears the cattle plague he may be disposed to believe that it has at length reached him; but of this he cannot be sure until the other more characteristic symptoms appear. Meanwhile the necessity is urgent

for the utmost care being maintained in disinfecting every person, place, or thing that has once been in contact with the disease wherever it has unmistakeably declared itself. Sheds, utensils, recovered animals, clothes, yards, manure, must be carefully disinfected or the plague will come again.

The disease has at length everywhere created fright enough to ensure the adoption of careful measures, and a wholesome public opinion having at length grown up, has declared itself in extremely stringent legislation, and we may therefore hope with some reason that we shall be able at Midsummer to report a diminution of the plague.

Among the other topics of agricultural interest which have arisen during the past quarter, we may name the first general attempt to collect the agricultural statistics of the country. Returns of the number of heads of various farm stock are being made this month by every occupier of land; and we shall soon know, with some degree of certainty, what are the numbers on which we depend for food, and what proportion to our actual stock is borne by the losses to which cattle plagues and other epizootics make us liable. A commencement having at length been made, we may hope that measures will by-and-by be taken for ascertaining and publishing from year to year the food-producing power of the country in the other important departments of its agriculture.

Mr. Alderman Mechi has read a paper before the London Farmers' Club on the tillage of the country, in which he declares its insufficient depth and general lack of efficiency in order to the full development of fertility. Plants go great depths for their food; and young crops are obviously benefited by hoeing and stirring the land during their growth. These are the two facts on which he bases his argument for the greater depth and thoroughness of tillage operations. The extension of cultivation by steam-power is one chief end to be desired, as being in itself the principal means to the attainment of such fertility as thorough tillage can develop.

Mr. Denton, C.E., and Mr. Grantham, C.E., have called attention to the great need of storing up in country places, for farm and village use, the drainage-waters of the neighbourhood. The want of water in many places, especially where either deep clay or deep chalk exists, is a very heavy agricultural burden and a great social calamity; and on both grounds the drainage-water, which is the very best available in such cases, ought to be stored in winter time against summer drought. The excessive rain-fall of the past season, following as it has two very dry summers, the difficulties arising from the drought of which will not soon be forgotten, makes the urgency of this question all the more apparent.

The Educational Committee of the English Agricultural Society have published the results of their first year's experience. No fewer

than 120 boys, the sons of farmers or intending an agricultural life, competed for the Society's prizes at the recent Cambridge University Local Examinations; and it is believed that some agricultural interest has been excited, and some agricultural good therefore been achieved. We believe that the efficiency of the Agricultural Society's prizes will be much greater, and their results will be more immediate, when they are offered exclusively for such evidence as examinations can test of competency, proficiency, and excellence (not in the several branches of ordinary school training, but) in the several departments of a strictly agricultural and professional education.

The condition of the agricultural labourer under the systems of payments in "kind" and by money respectively has been discussed. In Dorsetshire the payment is very largely by perquisites of various kind—cottage and garden free, wheat at a reduced price, &c., and only partly by a weekly money wage; and only the last particular being published, an undue impression of the hardships of the Dorsetshire labourer has arisen. In many districts of Scotland, too, wages are to a great extent given in meal, in a cow's keep, and so on, and the result, they say, is advantageous for the labouring man. Lord Shaftesbury declares the advantages of the somewhat similar system in Dorsetshire. But these advantages are altogether denied by the Rev. Lord S. G. Osborne, another Dorsetshire philanthropist; and we entirely sympathize with the latter in the belief that, as we have no right to treat labouring men as if they were children, incapable of looking after their own interest, or to enforce a system of payment upon them lest they should waste their means, so also, any such enforcement tends to the maintenance of a childish helplessness and improvidence, out of which trouble and distress are sure to grow.

The report by Mr. Lawes, of Rothamsted, on the experiments undertaken for Government to determine the relative values of unmalted and malted barley as food for stock, has been published. From the extent of these experiments and the great care with which they were carried out, we should judge the result to be entirely trustworthy. And it clearly proves that the waste of nutritive material in the process of malting is so great, that whether the dry matter of malt or that of barley, by itself, be the more nutritive or not, there clearly is less food in the malt derived from a given quantity of barley than there was in the barley from which it was made.

II. ASTRONOMY.

(Including the Proceedings of the Royal Astronomical Society.)

Professor Grant, F.R.S., of the Glasgow Observatory, has been for some time past engaged in the determination of the difference of longitude between the Observatories of Greenwich and Glasgow by galvanic signals. The method adopted was that of double registration, which has been practised so successfully in the United States of America, and more recently in Europe. The principle of this method is extremely simple. When a star passes each of the successive wires of the transit telescope of the more eastern of the two Observatories, the observer, by tapping a key with his finger, completes a galvanic circuit, and the instant of transit is recorded on the chronographic apparatus of the Observatory; but the galvanic current, instead of going to earth, is made to pass along the line wire to the recording apparatus of the distant Observatory, upon which also the instant of transit is in the same way recorded. A process exactly similar is repeated when the star comes to the meridian of the more western Observatory, the instant of transit being registered on both chronographic apparatuses by the same completion of the galvanic circuit. In this manner each signalling star supplies two pairs of recorded times of transit, a comparison of the individual values of which gives two distinct results, the one indicating the difference of longitude between the two Observatories, the other assigning a value of the time occupied by the galvanic current in its passage from the one Observatory to the other. The period of operations extended from April 28 in the past year to May 26. The stars selected for observation amounted in number to twenty-eight, and were arranged in four groups of seven stars each, and in such a manner that when the last star of any group had passed before the telescope of the Glasgow Transit Circle, which was the more western instrument, the first star of the succeeding group was nearly about to commence its passage over the wires of the Greenwich or more eastern instrument.

The weather on the whole was not favourable for simultaneous observations at both Observatories during the period of four weeks over which the operations extended. In several instances observations were made at Greenwich which could not be responded to from Glasgow, and in one or two instances the converse of this happened. On four nights, however—May 1, May 2, May 22, and May 25—the sky was favourable for observation at both Observatories, and it is upon the results obtained on those nights that the determination of the difference of longitude is exclusively based.

Collecting together the mean values of the difference of longitude for the four days, we have

	Difference of Longitude. m.	s.
May 1	17	10·680
2		10·648
22		10·433
25		10·463

Combining these together with a due regard to the number of observations on each day, we obtain for the definitive value of the longitude of the Transit Circle of the Glasgow Observatory,

$$17^m\,10^s\cdot 55 \text{ W.}$$

Similarly, for the time of the current's passage,

	s.
May 1	0·023
2	0·037
22	0·035
25	0·018

Whence we obtain definitively

$$\text{Time of Current's Passage} = 0^s\cdot 029$$

Proceedings of the Royal Astronomical Society.

M. Chacornac, in a letter dated 24th October, 1865, addressed to the President of the Royal Astronomical Society, refers to the continuation of his researches on the physical constitution of the Sun; and states that after various observations he has arrived definitively at the conclusion that the Sun is at least as luminous at its centre as in the brilliant envelope which bounds its visible contour.

The Society also received from Mr. A. Brothers a sheet of photographs of the Moon, taken during the Eclipse on the 4th October, 1865, with his Equatorial telescope of five inches aperture. Mr. Brothers writes that the prints must not be looked upon as photographs of the Moon, as many very much superior have been taken, but merely as pictures of the Eclipse. The atmosphere was so much disturbed during the whole time of the Eclipse that the sharpness of detail is lost to a great extent. He attempted to obtain the entire outline of the Moon, but failed to get more than greater sharpness of the shadow; this will be seen in No. 10, which was exposed fifteen seconds; Nos. 8 and 12 were exposed three seconds, and the remainder from one to about two-tenths of a second.

At the December meeting of the Royal Astronomical Society, Professor Grant gave a verbal account of his successful experiments in distributing accurate time over the City of Glasgow. He stated that, in the time-signalling operations at Glasgow, Jones's method

of regulating clocks is exclusively used. It is generally known that, according to this method, the electric fluid is employed merely as a regulating agent, and not in any case as a motive power, the time-piece under control being an ordinary clock, connected by a regular succession of electric pulsations with the normal mean-time clock of the Observatory. The application of the invention in Glasgow has been perfectly successful. It has been employed under various forms; but what Professor Grant considered to be the most suitable to the requirements of a large city was the small clock with a seconds' pendulum and a dial of about three feet in diameter, showing the time to hours, minutes, and seconds. Clocks of this construction have been set up in the public thoroughfares of Glasgow, and have been found to be exceedingly useful. Attached to each of them is a galvanometer, which, by its deflections, gives an indication of the electric currents transmitted in successive seconds from the normal mean-time clock of the Observatory, and a break in the transmission of the currents, once in every minute, namely, at the sixtieth second, of the Observatory clock, supplies the public with an unerring criterion for testing the accuracy of the controlled clock. There were now eleven clocks of various forms in Glasgow under the electric control of the mean-time clock of the Observatory. In a short time the number would be increased to some seventeen or eighteen, and the system was gradually extending over all Glasgow. The going of these clocks was truly marvellous. From week to week and from month to month they continued to indicate the time with the utmost precision, requiring merely a little attention now and then to the battery power. It was one of the advantages of Jones's method of control that, even in the case where the operations were on an extensive scale, only a small amount of battery power was necessary. There was one other remark which he would make, and it had reference to turret-clocks. Hitherto it had been usual, in the operations for placing one of such clocks under control, to remove the two seconds' pendulum, and to substitute for it a seconds' pendulum, which was made to beat in exact unison with the pendulum of the Observatory clock. Objections to this practice have been expressed by many persons who consider that a heavy pendulum vibrating once in two seconds is much better adapted than a light seconds' pendulum for maintaining the steady going of a clock fitted up in a lofty tower, the dials and hands of which are necessarily exposed very much to the action of high winds. After a good deal of experiment, Professor Grant found that the two seconds' pendulum might be retained and kept under complete control by attaching a large wire coil to the bob, and using a more powerful system of magnets in combination with it.

Messrs. Warren De la Rue, Stewart, and Loewy have examined

the Kew photographs of the sun, as regards the decrease of actinic effect from the centre to the circumference of the sun, which is, without doubt, caused by the presence of a comparatively cold solar atmosphere.

In conformity with their views, this atmospheric effect ought to be greater at the epoch of maximum than at that of minimum spot frequency; and furthermore, if there is any reference to ecliptical longitudes in the behaviour of spots—that is to say, if at any time the spots on the sun attain their maximum at any ecliptical longitude, there ought (according to these views) to be a greater amount of absorbing atmosphere at the same longitude, since such an atmosphere is supposed conducive to the outbreak of spots.

There is reason to think that spots attain their maximum in the ecliptical longitude opposite to that where Venus exists, so that we might expect (according to these views) a diminution in atmospheric effect in the same longitude as Venus, and an increase in their effect in the longitude opposite to Venus. If, therefore, Venus be at the longitude of the left limb of the Sun, this limb should exhibit less atmospheric effect than the right limb, and if Venus be at the right limb, we should have most atmospheric effect at the left limb.

It appears, from a joint and careful investigation of the Kew pictures by Miss Beckly and Mr. Stewart, that

(1.) When Venus is considerably to the left, there is most atmospheric effect to the right.

(2.) When she is in conjunction or opposition, there is a tendency to equality.

(3.) When she is considerably to the right, there is most atmospheric effect to the left.

Referring to these solar photographs, the President of the Astronomical Society stated, at the January meeting, that the Kew photographs are now taken by Miss Beckly, the daughter of the mechanical assistant of Kew; and it seems to be a work peculiarly fitting to a lady. During the day she watches for opportunities for photographing the Sun with that patience for which the sex is distinguished, and she never lets an opportunity escape her. It is extraordinary that even on very cloudy days, between gaps of cloud, when it would be imagined that it was almost impossible to get a photograph, yet there is always a record at Kew.

Mr. De la Rue remarked that all these investigations on the solar spots occupy a considerable time, and that the results may be interpreted differently by different persons. All that we have to do is to record faithfully the result of our observations; and it is hoped the Kew photo-heliograph will conduce very much to the advance of solar physics. Some time ago some experiments were made by

the speaker, in taking solar spots on a very large scale, the pictures of the Sun's disk being on a scale of 3 feet for the Sun's diameter. There are certain difficulties in taking those pictures by means of a reflector; but Mr. Cooke has recently undertaken the construction of a 13-inch refractor, which it is intended to apply to solar and lunar photography.

On the 9th February, the forty-fifth annual general meeting of the Astronomical Society took place, and the report of the council was read by the President, Warren De la Rue, F.R.S. Before commencing, he announced the gratifying fact that although the medal awarded to Professor Bond, of the United States, did not reach that country till after his lamented death, yet he was some time before his decease made aware of the honour that had been conferred upon him, and of the grounds on which the award had been made.

After the usual obituary notices of deceased Fellows, the President gave an account of the proceedings of various observatories, and then touched upon the progress made in different branches of astronomical science during the past year.

Among the most remarkable of modern astronomical discoveries, and, until a year ago, certainly among the most unexpected accessions to our knowledge, is that which has come to us latest in the order of discovery. We refer to Mr. Huggins's observations on the spectrum analysis of the light from a comet. The light of the nucleus of Comet I. 1866, as examined under his instrument, gives a spectrum consisting of but one bright line, whereas the spectrum formed by the light from the coma gives a spectrum which is continuous. The inevitable conclusion to be drawn from these observations is opposite to that which our prepossessions would have led us to expect, inasmuch as, consistently with the present state of our physical knowledge, we are forced to conclude that the light of the cometary nucleus examined by Mr. Huggins must have emanated from a gaseous source; whereas, guided partly by other physical considerations, no doubt remains that the coma contains fluid or solid materials. Thus the suspicion of analogy between cometic and nebular matter has received this further confirmation. No doubt difficult observations of this nature require repetition, but the known caution and experience of the observer invite our confidence.

III. BOTANY AND VEGETABLE PHYSIOLOGY.

England.—Mr. Darwin, in an interesting paper "On the Phenomena of Motion and Sensitiveness in Climbing Plants," has shown that the unsupported, outstretched extremity of a hop or convolvulus continues to revolve in circles, ever widening as it grows, and has calculated the rate of revolution, which varies in different plants, increases or decreases with a rise or fall of temperature, is diminished by any disturbance such as jarring or moving the plant from place to place, and varies also with the age and the general health of the plant. Mr. D. also experimented on the sensitiveness of the petioles and internodes of such plants as the clematis, &c., which climb by their leaf-stalks. Some of the experiments were very delicate. "A loop of thread," says Mr. D., "weighing a quarter of a grain, caused the petiole to bend; a loop weighing $\frac{1}{8}$th of a grain sometimes acted, and sometimes not. In one instance, the weight of even the $\frac{1}{16}$th of a grain, brought into continuous contact with the petiole, caused it to bend through nearly 90°." "Young internodes alone are sensible on all sides along their whole length." An internode, "rubbed six or seven times with a twig, became just perceptibly curved in one hour and fifteen minutes, and subsequently, in three hours, the curvature increased much; the internode became straight again in the course of the night." In numerous cases, particularly in *Solanum Jasminoides*, the clasping petioles increase in rigidity and thickness, the fibro-vascular bundles undergoing a change in their arrangement, so that from being originally semi-lunar on the cross-section, they develop into a close ring like that of an exogenous stem. Mr. Darwin thinks that both "leaf-climbers and tendril-bearers were primordially twiners; that is, are the descendants of plants having this power and habit." He regards plants which climb by tendrils as the highest type of climbing plants.

The following interesting and curious results were obtained from experiments on tendril-bearers. "A loop of soft thread, weighing $\frac{1}{32}$nd of a grain, placed most gently on the tip" of a tendril (*Passiflora gracilis*), "thrice plainly caused it to curve, as twice did a bent bit of platinum-wire, weighing $\frac{1}{50}$th of a grain; but this latter weight did not suffice to cause permanent curvature." After being touched with a twig, the tip of a tendril begins to bend in from 25 to 29 seconds. Transient irritation causes a tendril to coil into an open helix, but it soon straightens itself again, recovering its sensibility. If, however, left in permanent contact with the irritating object, the spiral coil continues. It is a remarkable fact that no curvature of the tendril results from the touch of other tendrils, or the impact of drops of rain, to which

they appear to be habituated. Of Cucurbitaceous tendrils, next to *Sicyos* the most active are those of *Echinocystis lobata*. The internodes and tendrils of this plant revolve in about $1\frac{3}{4}$ hour; the former sweeping a circle or ellipse 2 or 3 inches in diameter, the latter often one of 15 or 16 inches in diameter. If a full-grown cucurbitaceous tendril fails to lay hold of an object, it soon ceases revolving, bends downward, coils up spirally, and ultimately withers and falls off; should it succeed in attaching itself, however, to a support, on the contrary, it thickens, hardens, and gains wonderfully in strength and durability. The contraction of tendrils into a spiral coil renders them highly elastic, and therefore in a gale of wind powerful organs of defence. Mr. Darwin says that the tendrils of *Bignonia capreolata* avoid the light, crawling into dark holes and crevices after the manner of roots. The tendrils of this plant will clasp a smooth pole, but soon detach themselves and straighten; a rough, fissured, and porous surface alone satisfies them, such as the bark of trees, to which they attach themselves. *Ampelopsis quinquefolia*, or the Virginia Creeper, also avoids the light, uniformly seeking dark crevices or broad flat surfaces, as a wall, a rock, or the trunk of a tree. The tips of the tendrils, brought into contact with such a surface, swell out, and form in a few days those well-known discs or cushions by which the plant firmly adheres to its support.

The learned and accomplished lichenologist, Dr. W. Nylander, has described, during the past year, 23 new species of British lichens; *viz.*, one new species of each of the following genera, Collema, Leptogium, Pyrenidium, Calicium, Lecanora, and Opegrapha, two new species of Pertusaria, five of Lecidea, and twelve of Verrucaria. Some of these lichens are so small, that they certainly required for their detection great nicety of botanical discrimination; as, for example, *Verrucaria tristicula*, Nyl., which was discovered by Admiral Jones on Moss (*Weissia*), in Aberdeenshire, and *Lecidea contristans*, Nyl., discovered by Isaac Carroll, Esq., on decaying Andreæ, on the summit of Ben Lawers.

Dr. Nylander has also described a collection of lichens made in New Zealand, in 1861, by Dr. Lindsay, including 26 genera and 117 species. Many of these lichens are common to Britain, Scandinavia, and the United States. We notice in the list seven species of Lecanora and Lecidea, three species of Opegrapha, two species of Sticta and Pertusaria, and one species of Arthonia, Platygrapha and Physcia, for the first time described by Dr. Nylander, and therefore new to science. Among the rarer and more interesting species in the collection, already described by other botanists, are Collema leucocarpium, Tayl., Bæomyces fungoides, Ach., Cladonia retepora, Flk., and Stictina fragillima, Bab.

Three new British flowering plants have been discovered.

Hedera Canariensis, described by Professor Babington,* "on old white-thorn trees, Phœnix Park, near Dublin;" *Rosa collina*, Jacq., discovered near Plymouth by Mr. T. R. A. Briggs; *Eurucastrum Pollichii* (*Eurucastrum inodorum*, Reichen.), collected by Mr. Joshua Clarke, near Saffron Walden, Essex.

Mr. F. E. Kitchener sends us a 'First List of Flowering Plants and Ferns found within Four Miles of the Close, Rugby.' Mr. K. publishes the list "incomplete, in the hope that additions will be sent." Botanists will be careful to mention the localities in which the plants are found, and their "earliest and latest dates of flowering." We would suggest to Mr. K., that the next list will be improved by avoiding the typographical errors which occur in this one, and by the substitution of the Botanical for the English names of the Families, as more appropriate and equally intelligible to the practical botanists, for whose use this list is printed.

Mr. J. Miers describes † 69 new species of *Cissampelos* (Menispermaceæ,) of which 46 belong to America, 11 to Africa, and 12 to Asia. The plants throughout the genus are diœcious, excepting in two or three instances where monœcious flowers occur; in one, the sexes are found in distinct racemes on the same plant, and in another the male and female flowers are on the same raceme (*androgynous*). Mr. M. denies that *Cissus Pareira* is the normal type from which these species are derived, and thinks that "nothing in the shape of sustainable evidence has been offered to prove" such a position. But supposing it to be true that all these species have thus originated, "if such modifications be now permanent, each confined within a limited range of distribution, and we can assign to them severally constant and determinable characters, then clearly, according to the rules of science, they ought to be considered distinct and valid species. In determining different kinds of plants, the practical botanist should not be guided by any theory of the distant origin of species, but should regard them in their present forms." There is some force in these remarks of Mr. Miers.

Mr. Isaac Seaman, M.R.C.V.S., says that sprouted grain is a superior nutritious cattle-food, and "an excellent substitute for the turnip and green rape of winter, and the different clovers and grasses of summer." Mr. Seaman affirms that, "during the past season, a very large number of lambs have been reared, thousands of sheep fattened, and upwards of twenty different flocks restored to health, by the use of semi-malted grain." That semi-malted grain should be a nutritious cattle-food is not at all unreasonable, and probably owing to the conversion of the starch of the grain into sugar, which, for both plants and animals, is more nutritious than starch, because more readily absorbed into the circulation.‡

* 'Journal of Botany,' December, 1865.
† 'Annals and Magazine of Natural History,' February, 1866.
‡ 'Veterinarian' for February, 1866.

The herbarium at Kew has recently acquired two very valuable private collections, Dr. Burchell's South African and South American collection, by gift from his sister, and the herbarium of Orchids of the late Dr. Lindley, by purchase. The latter contains upwards of 3,000 species, in perfect condition, fastened upon cartridge-paper and copiously illustrated with dissections and sketches by Dr. Lindley's own hand, and from other sources.

An international botanical congress is to be held in London on the 22nd and 25th of May, 1866. President, M. Alphonse de Candolle. The congress is restricted to two morning meetings. Two conversazioni and a banquet are announced to be held in the Guildhall, and to which the leading foreign visitors are invited as guests. Botanists desirous of reading a paper must forward MS. to Dr. Seeman, 57, Windsor Road, London, N., not later than the 31st of March.

The second part of the 'Genera Plantarum,' by Dr. Hooker and G. Bentham, F. L. S., &c., is published. It contains the Leguminosæ, Rosaceæ, Saxifragaceæ, Haloragaceæ, Rhizophoreæ, Combretaceæ, and Myrtaceæ. The recent illness of Dr. Hooker has delayed his revision of the Melastomaceæ, which may be expected next summer in the third part of the 'Genera Plantarum,' and this part will complete the Polypetalous orders and the first volume of 1,000 pages.

Sweden.—The Academy of Sciences at Stockholm is about to publish a *fac-simile* of a very interesting relic—a photo-lithographic copy of the first edition of the 'Systema Naturæ' of Linnæus, a folio of about fourteen leaves. Though very thin, it contains the groundwork of nearly all that the great Naturalist has accomplished.

America.—A catalogue of plants found in Oneida County, New York State, has been recently published by the authorities. This catalogue embraces the whole of the central part of the State of New York, and its author, Mr. John A. Paine, jun., has expended a great deal of labour in its preparation. Eighty-one native plants (species and varieties) are enumerated at the close, which are additions to the Flora and Catalogue of the plants of this State by Dr. Torrey. Twenty-five new plants are enumerated as naturalized. Professor Asa Gray says, "For a public document, this catalogue is well-printed, and as a hasty essay by an unpractised hand, it is creditable to its author, although there are many points which would not bear close criticism." *

At a recent meeting of the American Philosophical Society in Philadelphia, it was stated that the native plants of Pennsylvania were being rapidly displaced by the European flora. European

* 'Silliman's Journal,' January, 1866.

plants, formerly described as rare, were becoming plentiful. This change of the American flora was attributable to the spread of railway communication. Some of the botanists present thought that the foreign flora would supplant the native in a, comparatively speaking, very short period.

France.—In the 'Bulletin Générale de Thérapeutique,' Jan. 15, 1866, M. Stanislaus Martin describes a new medicinal plant called in Brazil *Jurubeba* (Solanum paniculatum), which is sold there commercially in the state of leaves, fruit, and roots. The plant is used in the form of emplastrum, syrup, wine, tincture, aqueous and alcoholic extract. It is chiefly employed in affections of the liver and spleen, in vesical catarrh, anæmia, chlorosis, and difficult menstruation. According to reliable testimony, this new drug promises to be the most powerful deobstruant yet met with.

Pumpkin-seeds are again in France popular with the profession as a remedy for tape-worm. M. Bouvier, in the 'Archives Médicales Belges,' relates his successful treatment of a little German boy five years of age, and Dr. Desnos reports two cases in the 'Journal de Chimie Médicale.' Dr. D. says that the results are still more favourable when the resinous extract of male fern (Aspidium filix-mas) is combined with the pumpkin-seed preparation.

At each session of the French Academy, January, 1866, M. Ad. Chatin read a botanical paper. In the first, "On the Tendrils of the Cucurbitaceæ," read January 2, 1866, M. Chatin states the facts as revealed by the microscopic examination of the anatomy of the tendrils, simple and branched, of the different genera of the order, and compares them with the microscopic anatomy of the other organs of the plant—*viz.* stem, leaf, petiole, peduncle, roots ordinary and adventitious, and deduces from them the following results:—1. The tendrils of the Cucurbitaceæ are of axile origin (either a branch or a peduncle). 2. If the tendril is simple, its homology is invariably with the axile organs; if, on the contrary, it is branched, its divisions correspond sometimes to the leaves and occasionally to the axile organs. 3. There is no relation of origin between the tendril and the ordinary roots; there is, however, a relation existing between the tendril and the adventitious roots. In his paper, read January 15, "On the Existence of a Third Membrane in Anthers," M. Chatin says, the opinion generally adopted amongst botanists is, that the valves of anthers are composed of two membranes, which were named by Purkinje *exothecium* and *endothecium*. But there exists always during a certain phase of the development of the anthers, a third membrane, more interior than the *endothecium*, which is the true *endothecium*. The endothecium of Purkinje should therefore now be denominated the *mesothecium*. The development of the cells of this third membrane and that of the pollen cells takes place together up to the period of the maturation

of the pollen, when it disappears, having aided in the development of the pollen, no traces of it remaining except a granular matter on the superficies of the second membrane, or endothecium of Purkinje. Amongst other characteristics, this third membrane is distinguished by its colour, which is invariably the same as that of the pollen, which it nourishes and brings to maturity.

M. Chatin's third paper is "On the Localization of the Fibre-cells in some Anthers, and their Absence in others." The following is a *résumé* of the facts connected with this subject. The fibre-cells exist only upon given points of the anther valves, and are localized in connection with the following types:—*a*. The fibre-cells are disposed along the line of dehiscence (*Rhinanthus*). *b*. They are situated in the anthers longitudinally, or towards the line of detachment of the valves or connective (*Chlora*). *c*. They exist only at the extremities of the cells close to the pores of dehiscence (*Solanum*). *d*. They are borne only by one of two valves (*Witheringia rubra*). *e*. They are localized upon the uplifted valves (*Laurus*). *f*. They extend beyond the valvules (*Berberis*). *g*. They are scattered and with incomplete threads (*Orchis mascula*). M. Chatin thus sums up the result of his investigations in reference to the absence of the fibre-cells from anthers:—*a*. Anthers dehiscing by terminal pores are deprived of fibre-cells. *b*. Fibre-cells are defective in a certain number of anthers, having longitudinal dehiscence. *c*. In plants whose stamens are suddenly arrested in their development, whether morphologic or histologic, the absence of the fibre-cells coincides with the incomplete evolution of the pollen.

In his paper "On the Placentoid, a New Organ in Anthers," read before the Academy on the 29th of January, M. Chatin says that the function of this organ—which is so called from its analogy with the placenta of the ovule in the ovarian cell—is to nourish the pollen. It appears at the same epoch as the pollen, follows it in its development, and disappears when the pollen is mature. The Placentoid is absent from the Monocotyledons; it is wanting in the Monochlamydeæ and Thalamiflora, and M. Chatin would also add Calyciflora, if he had not observed it in *Cassia Marilandica*. He thinks that the presence of the Placentoid in the Corolliflora settles the long-controverted question as to the precedence of the Dicotyledonous classes and proves that Gamopetalous exogenous plants are more highly organized than Dialypetalous exogens, and that among these, the families with the ovary united to the calyx should rank above those with the ovary free, that is to say, above the corolliflora.

All botanists have noticed that a deposit of carbonate of lime forms on the leaves of Chara, Hippuris, and other submerged aquatics. MM. Cloez and Gratiolet supposed that this deposit was formed at the moment when the leaf absorbed from the water the

carbonic acid which held the lime in solution. In a paper entitled "Chemical Researches on Vegetation, Functions of Leaves," read before the French Academy on the 12th of February, M. Corenwinder says that he repeated the experiments of Ingenhousz on the leaves of aerial plants—that is to say, he exposed them to the sun in bell-glasses, filled with water from a spring, which held bicarbonate of lime in solution, and found that the leaves became covered with a deposit of pure carbonate of lime. M. Corenwinder has thus verified the fact which M. Gratiolet only suspected. In the same paper M. Corenwinder says that leaves coloured wholly or in part, white, yellow, or red, in consequence of exhaustion, must be distinguished from those leaves which are normally these colours when their vitality is in all its plenitude; that the former do not produce oxygen under the influence of the solar rays, whilst the latter give it forth in abundance. Buds and leaves just issuing from them give off carbonic acid even in sunlight, which, however, decreases as they develop themselves, the amount of oxygen continually increasing until the leaves are adult and complete, when oxygen only is given off during the day. But if a plant is placed at a distance from a window in an apartment, or in a shady place, it gives off carbonic acid during the day, which varies in amount according to the nature of the plant and the feebleness of the light. This explains the difficulty experienced in preserving plants in an apartment.

IV. CHEMISTRY.

(*Including the Proceedings of the Chemical Society.*)

A QUESTION of as much interest to Chemistry as to Meteorology has recently been discussed at the Academy of Sciences. It relates to the presence of ozone in the atmosphere; and it elicited the opinion of some of the most eminent French chemists that none of the tests in ordinary use can afford satisfactory evidence on the question. It was shown, indeed, by M. Frémy, that Schönbein's paper is affected by many bodies likely to be present in the air; by the oxides of nitrogen, by peroxide of hydrogen, by the acid products of combustion, and by many other bodies, whose presence is not improbable. Further than this, the instability of ozone in the presence of organic matters and nitrogen, would lead to the conclusion that it must be destroyed as soon as formed in the atmosphere. The one test which will prove conclusively the existence of ozone in the air, M. Frémy said he had tried many times without obtaining the faintest indications of its presence. As the question is of great interest, we state that the test on which M. Frémy relies, is the oxidation of silver by a current of moist air. With

regard to one body which is likely to be present in the air, and which would equally affect the iodide of potassium paper, *viz.* peroxide of hydrogen, we may state, that M. Houzeau has just announced* that he has proved its presence in water condensed from moist air.

While on this subject we may notice the statement of M. Jean, that carbonic acid under the influence of the electric spark splits up into carbonic oxide and oxygen, which latter is strongly ozonized.

The persistent white vapours obtained by the slow combustion of phosphorus in the air, and supposed by Meissner and others to be antozone, has been shown by Ozann to consist of nitrite of ammonia, thus confirming a statement to the same effect already published by Schönbein.

M. Soret has carried on some researches to ascertain the density of ozone, which he considers he has established to be one-and-a-half times that of oxygen, *viz.* 1·658. A consideration of the volumetric relations of ozone and oxygen would lead to the same conclusion, which the author above named considers he has proved by experiment.†

One unpleasant but important duty of a scientific chronicler is often to contradict things he has published before as facts. In our last volume (p. 278), we quoted the statement of MM. Moutier and Dietzenbacher, that by melting sulphur with small quantities of iodine, paraffine, and many other substances, they had converted it into a permanently soft and plastic mass. We have now the assertion of M. Keller,‡ that after repeating all the experiments of the above-named authors, he has never succeeded in producing a plastic mass unless the melted sulphur was poured into cold water, in which case, as is well known, sulphur is always rendered plastic for a time.

A paper by Dr. Wetherill, "On the Allotropic Modifications of Sulphur,"§ may be consulted by those who take an interest in this curious subject.

Professor W. H. Miller has been engaged in determining the crystalline forms of the graphitoidal varieties of boron and silicon. The latter he has ascertained to crystallize in octohedrons, while the crystals of graphitoidal boron appear to belong to the oblique system.

A discovery made by M. St. Claire Deville is likely to have important technical results. The magnesia obtained by calcining the chloride or nitrate of magnesium, when exposed to water, becomes converted into a compact crystallized hydrate of great

* 'Comptes Rendus,' Feb. 26, p. 430.
† Ibid., Nov. 27, 1865.
‡ 'Bulletin de la Société Chimique,' Nov., 1865.
§ See 'Chemical News,' vol. xiii., pp. 89, 97.

durability. A mixture of the same magnesia with chalk or powdered marble made into a plastic mass, and placed in water, soon becomes extremely hard; and M. Deville hopes in this way to get a modelled bust converted into artificial marble.

Dolomite calcined at a low red heat and powdered, and then made into a paste, forms under water a stone of extraordinary hardness.

It has long been known that calcined magnesian limestone forms a very strong hydraulic cement; and Dr. C. Calvert has shown that the strength of the cement is in direct proportion to the amount of magnesia. Dr. Calvert also confirms the statement of M. Deville, that the calcination of magnesian stones must be carefully managed, too high a temperature completely destroying the hydraulicity of the material. It seems important also that the calcined product should be very finely ground to improve the setting.

Harrogate water has long enjoyed some celebrity as a remedial agent, but the recent analysis of one spring by Dr. Sheridan Muspratt* is likely to bring it into still greater repute. The eminent chemist above named has discovered in what is known as the "Cheltenham spring," a large proportion of *protochloride of iron*, as much indeed as 16·011 grains in the imperial gallon. This, therefore, is the strongest chalybeate spring known, and as the condition in which the iron exists is one of the most favourable for its assimilation by the animal economy, the water is likely to prove most efficacious in all those affections, too numerous to mention, for which iron is prescribed. It deserves mention that chloride of barium is also present in the water in unusually large quantity, but this will not detract from the medicinal value of the spring.

Passing to the mention of other mineral elements, we find an easy method of accomplishing what has hitherto been found a difficult object. It is a process by M. Terreil, for separating cobalt and nickel in minute quantities. To a solution containing the two metals together with manganese, the author adds ammonia, until the precipitate first formed is redissolved. He then makes the solution hot, and adds a solution of permanganate of potassium until the mixture acquires a permanent violet colour. After this the solution is boiled for a few minutes with a slight excess of hydrochloric acid, and after having been kept hot for some time, it is set aside for twenty-four hours. At the end of this time the cobalt is deposited as roseo-cobaltic hydrochlorate, 100 parts of which contain 22·71 of cobalt. To separate the nickel in the residual liquor, the manganese is precipitated by first saturating the liquor with ammonia, and then adding an alkaline hypochlorite. This throws down all the manganese, and the nickel remains in the solution, from which it

* 'Chemical News,' vol. xiii., p. 26.

may be separated by sulphuretted hydrogen. The full details of this process will be found in the place indicated below.*

On organic chemistry an immense number of papers, for the most part of a theoretical character, have been published. Our space allows us only to mention a few of a practical and generally interesting nature. We must, however, first advert to one most important discovery, which illustrates the practical aim of the studies of our most advanced chemists. It is the production of *Phenose*, a body possessing all the chemical characteristics of sugar, by Carius, from benzole. The steps by which this wonderful transformation was effected could only be made intelligible by a long description, and we must content ourselves with the bare mention of the fact, referring the reader interested to the original paper.†

A useful test for discriminating between glucose and cane sugar has been discovered by Nicklés, who finds that the latter when heated with bichloride of carbon in a sealed tube becomes black, while the former (glucose) remains of its original colour.

Another test for glucose is given by Braun,‡ who heats the glucose with some solution of caustic soda, then adds a few drops of a solution of picric acid, and boils. A solution containing much glucose now changes to a deep blood-red colour, weaker solutions showing lighter shades of red. Cane sugar does not produce the same effect. The above test is recommended to physicians for detecting sugar in urine.

A new process for the production of an aniline black has been devised by M. Paraf, which however is open to the objections stated below. The process is said by the inventor to produce a black without the intervention of a metallic salt, and is as follows:—Hydrochlorate of aniline is dissolved in a solution of hydrofluosilicic acid, and chlorate of potassium is either added to the mixture, or the mixture properly thickened is printed on cloth prepared with chlorate of potassium. Upon heating the printed cloth to 90° or 95° F., a beautiful black colour is said to be produced. M. Lauth, however, states § that the black colour is caused by copper derived either from the vessel in which the mixture is prepared, or the roller with which it is printed. He states that when the solutions are prepared in porcelain or glass vessels, and the mixture printed by hand with a wooden block, only a dull grey colour is obtained.

M. Berthelot continues his important researches on acetylene, showing now its invariable production when hydrocarbons and hydrocarbonated bodies are submitted to incomplete combustion.‖ The experiment may easily be made in a test-tube with marsh gas

* 'Comptes Rendus,' for Jan. 15, 1866.
† 'Annalen der Chemie und Pharmacie,' December, 1865.
‡ 'Zeitsch. für Analyt. Chemie,' vol. iv., p. 187.
§ 'Bulletin de la Société Chimique,' Feb., 1866.
‖ 'Comptes Rendus,' vol. lxii., p. 94.

or a few drops of ether. The tube being filled with the gas or the vapour of ether, and a few drops of ammoniacal cuprous chloride added, the gas is ignited and the tube rolled about so as to bring the products of combustion in contact with the re-agent. The characteristic red precipitate of acetylide of copper will be produced wherever the flame touches the copper solution. The incomplete combustion of coal gas produces a notable amount of acetylene, recognizable by its peculiar odour as well as the chemical test.

Based on the production of acetylene from hydrocarbons, M. Berthelot has suggested a new method of detecting them in mixed gases.* If, for example, a mixture of carbonic oxide and hydrogen or of hydrogen and marsh gas, or any hydrocarbon vapour, be submitted to the action of the electric spark for a few minutes, acetylene will be produced in the latter mixture, but not in the former.

Lastly, M. Berthelot shows that the compounds which acetylene forms with metals offer examples of a new series of compound metallic radicals.† He describes at length those containing copper and silver, with some of their salts.

As a point of some technical interest, we may mention that M. Perret has discovered a process by which the first step in the preparation of citric acid may be taken where the lemons grow, and thus save the exportation of the fruit or juice. He first precipitates the acid with magnesia, so forming the tribasic citrate; this he afterwards boils with another portion of juice, by which he forms a bibasic citrate, an easily crystallizable and permanent salt, convenient to transport for the subsequent manufacture of citric acid.‡

In conclusion, we may mention that, after an elaborate investigation, Fresenius has shown that a mixture of air and carbonic acid, or either alone, is only completely deprived of moisture by passing over phosphoric anhydride.§

Proceedings of the Chemical Society.

At the meeting held on December 7, 1865, Dr. Gladstone communicated some Notes on Pyrophosphodiamic Acid, and Dr. Hugo Müller described Phenylo-phosphoric Acid and some of its salts.

The next meeting, December 21, was occupied with a paper by Mr. James Yates, "On the best Material for Mural Standards of Length." To extend knowledge of the metric system, it has been proposed to the British Association to set up standards on the outside walls of public buildings, and Mr. Yates's object in intro-

* 'Bulletin de la Société Chimique,' Feb., 1866.
† 'Comptes Rendus,' vol. lxii., p. 455.
‡ 'Bulletin de la Société Chimique,' Jan., 1866.
§ 'Zeitschrift für Analyt. Chemie,' vol. iv., p. 177.

ducing the subject at the Chemical Society was to obtain the opinion of chemists as to the most permanent material of which to construct the standards. He was himself in favour of bars of brass coated with gold or platinum, or speculum metal improved by the addition of a little arsenic. The general opinion of the meeting was perhaps in favour of graduated porcelain scales, such as used by Mr. Casella for barometers and thermometers, and upon which, as Dr. Frankland stated, the weather could have no influence. White glass, with a coloured surface which could be ground away to show the divisions of the scale, was also suggested.

On January 18, Dr. Gladstone read a paper on Pyrophosphotriamic Acid, and Dr. Wanklyn gave an account of his recent researches on the action of Carbonic Oxi le on Sodium Ethyl. Dr. Debus afterwards made some remarks on the constitution of Glyoxylic Acid.

On February 1, Dr. Gilbert gave a lecture "On the Composition, Value, and Utilization of Town Sewage." In the course of his lecture he gave a rapid review of the whole subject; but we must content ourselves with placing before our readers the following propositions with which the lecture was concluded:—1. It is only by the liberal use of water that the refuse matters of large populations can be removed from their dwellings without nuisance and injury to health. 2. That the discharge of town sewage into rivers renders them unfit as a water-supply to other towns, is destructive to fish, causes deposits which injure the channel, and emanations which are injurious to health, and is also a great waste of manurial matter. 3. That the proper mode of both purifying and utilizing sewage-water is to apply it to land. 4. That, considering the great dilution, constant daily supply, greater amount in wet weather, and cost of distribution, it is best fitted for application to grass, although it may be occasionally applied to other crops under favourable circumstances. 5. That the direct result of the general application of town sewage to grass land would be an enormous increase in the production of milk (butter and cheese) and meat, whilst by the consumption of the grass a large amount of solid manure, applicable to arable land and crops generally, would be produced. 6. That the cost or profit to a town of arrangements for the removal or utilization of its sewage must vary very greatly according to its position and to the character of the land to be irrigated. Under favourable circumstances, the town may realize a profit, but under contrary conditions it may have to submit to a pecuniary loss to secure the necessary sanitary advantages.

On February 15, Mr. G. T. Chapman read a paper "On the Action of Nitrous Acid on Naphthylanine." A paper by Mr. G. Davies was also read "On the Action of Heat on Ferric Hydrate in presence of Water," in which the author proved that water is

expelled from ferric hydrate by long boiling in contact with water. The author draws the conclusion that the natural beds of ferric oxide ore may have been deposited from aqueous solution, and become subsequently dehydrated by long exposure to a moderate heat.

The next paper read was by Professor Kolbe, "On the Prognosis of Alcohols and Aldehydes." It was of a purely theoretical character.

V. ENTOMOLOGY.

(Including the Proceedings of the Entomological Society.)

It is not often that entomological science is enriched with such works as the one recently published by Mr. T. Vernon Wollaston, entitled, 'Coleoptera Atlantidum; being an Enumeration of the Coleopterous Insects of the Madeiras, Salvages, and Canaries.' Since 1847, Mr. Wollaston has made several prolonged visits to one or another of those islands, and in this volume he brings together all that has yet been registered on the subject. His introductory remarks, extending to over forty closely printed pages, are well worthy the attention of all philosophic naturalists, and we can only regret that our space will not allow us to give more than a summary of two or three of them. Of the whole number of genera (423), including 1,449 species, not one is found characteristic of the true African region, but so many of these are endemic that Mr. Wollaston thinks we should hardly be warranted in referring them to the European fauna. The author inclines to the opinion that these islands were aboriginally stocked while yet a part of a continuous land, and that the numerous slight modifications or insular states "which now present themselves, have not been matured by any process of slow development," but were brought about at a very remote period, probably "when this great Atlantic province was rent asunder." Space will not allow us to enter on the author's arguments in support of this hypothesis; but we cannot avoid calling attention to the "marvellous types" characteristic of the Euphorbian fauna. In the Canaries especially, where whole tracts are covered with Euphorbias, not less than fifty species of Coleopterous parasites are *exclusively* confined to them, not indeed to the living, but to the dead plants, and are met with in such incredible numbers that "the rotten stalks and branches seem absolutely alive with them."

In a former number of this Journal (ii. p. 669), when giving an account of the discovery by Professor Wagner, of Kasan, of the "larvæ-producing larvæ" of the *Miastor metraloas*, we spoke of them as having seemed to him to have been developed from "embryonal bodies" belonging to the organism of the parent larvæ.

M. Ganine, of Karkow, has since, however, denied this statement, and describes the reproductive organs as two little sacs placed in the eleventh segment of the body, and in which the germs, or pseudo-ova, are developed. This account has been substantially confirmed by Dr. Leuckhart and M. Pagenstecher.

Dr. Asa Fitch, in his 'Reports,' &c., states that a new enemy to the bee has appeared in the Nebraska territory, and so great has been the destruction caused by it, that no swarm had been thrown off during the season, or at least up to the time of the Report. The insect in question—*Trypanæa apivora*—is a fly belonging to the family of Asilidæ, some of which are known in Europe to attack bees, wasps, and even insects so formidable and apparently so well protected as the tiger-beetles (*Cicindelæ*).

A work by M. A. Edouard Pictet, entitled 'Synopsis des Néuroptères d'Espagne,' has just been published at Paris and Geneva. It is, we believe, the first production of one who has hereditary claims to our attention had he no others, which, however, is far from being the case. The plates—fourteen in number—by the well-known artist Nicolet, are printed in tinted ink suitable to each insect figured, and coloured by hand. Only in this way could the delicate gauze-like wings of these marvellously exquisite creatures be portrayed, and this has been done with a success that may be almost pronounced perfect. The Libellulidæ are retained among the Neuroptera.

Entomological Society.

At the December meeting, the Secretary exhibited a general collection of insects made by Lieut. Bevan at Moulmein, and in the valley of the Solween. It was mostly composed of Indian and not Malay types. Mr. F. Smith exhibited numerous specimens of a moth used for food by the natives of New South Wales, and named by them "Bugong" (*Agrotis spini*, Guén.). It is found in large numbers in November and December, when their bodies are in a very oleaginous state. A beautiful series of engravings of the insects of the United States, together with their transformations, as far as they are known, made by Mr. Glover, of Washington, was exhibited by Mr. Moore. The Rev. Joseph Greene exhibited a series of *Acidalia subsericeata* and *A. mancuniata*, some of which appeared to throw a doubt on the claims of the latter to the specific distinction which it has been quite recently supposed to possess. Professor Westwood read descriptions of new species of *Cantharocnemis*, including two new genera or sub-genera? Mr. MacLachlan read a paper on varieties of *Sterrha sacraria*, with notes on the variation of species in the Lepidoptera. Mr. Semper (of Altona) sent drawings and a description of a remarkably fine new species of *Papilio* from the Samoa Islands.

January.—Mr. Stevens exhibited a collection of insects from the Himalayas, mostly Lepidoptera. Extracts of a letter from Prof. Snellen von Vollenhofen were read by Prof. Westwood. The writer stated that *Chareas granimis* and *Heliophobus popularis* had appeared in immense numbers in certain districts in Holland, and had proved very destructive. Mr. Bates gave the meeting some account of the proceedings of Mr. E. Bartlett, who had recently gone to the Amazons on a zoological excursion, and had already made his way up the Ucalayi, which may be considered the upper part of the main river, to nearly the latitude of Lima. Mr. Hewitson sent a paper containing descriptions of new species of Hesperidæ. The President (Mr. Pascoe) communicated a list of the Longicornia collected by the late Mr. Bouchard at Santa Martha. Of fifty-three species nearly half were new to science.

The anniversary meeting was held January 22. After the usual report of the proceedings and position of the Society had been made, and in which it was stated that fifty-nine new members had been elected since the previous anniversary, the President read his address, reviewing the progress of entomology during the past year; after which it was announced that Sir John Lubbock, Bart., F.R.S., &c., had been elected President; J. W. Dunning, M.A., &c., Secretary; and S. Stevens, F.L.S., &c., Treasurer.

February.—At the previous meeting it had been announced that one of the prizes offered by the Council for the best essay on economic entomology had been adjudged to Dr. A. Wallace, of Colchester, for his essay on Ailanthiculture. In now presenting it to the author, the President stated that the Council had decided upon again offering two prizes of five guineas each for essays of sufficient merit on any subject connected with the habits, anatomy, or economy of any insect or group of insects serviceable or obnoxious to mankind, the essays to be sent to the Secretary on or before the 30th November, 1866. Mr. S. Stevens exhibited a male of the rare *Papilio Semperi*, a butterfly with black wings and a bright scarlet body. Mr. W. Wilson Saunders brought for exhibition a numerous suite of *Heliconia Melpomene*, all taken at Cayenne, showing the excessive variation of colour to which the species was subject, and, consequently, how little reliance ought to be placed on *mere* colour alone in the discrimination of species, at least in that portion of the diurnal Lepidoptera. It is to be hoped that those Lepidopterists who are constantly favouring us with descriptions of "new species," which in many cases appear to depend on very slight differences of colour, will not be forgetful of its uncertainty as a specific character. Professor Westwood and Mr. MacLachlan called attention to remarkable gynandromorphous examples, the former of *Dytiscus latissimus*, the latter of *Argynnis paphia*. Mr. Hewitson communicated a paper describing seventeen new species of Hesperia.

XUM

VI. GEOGRAPHY.

(Including the Proceedings of the Royal Geographical Society.)

The death of Dr. Barth, to which we just alluded in our last number, will leave a void not easy to be filled. At the age of twenty-five, the young traveller had explored the southern coasts of the Mediterranean. He subsequently traversed Algiers, Tunis, Tripoli, and Benghazi, whence he was on his road to Cairo, when he was beset by robbers, plundered and wounded. He continued his journey, however, and visited Egypt, Syria, Palestine, Asia Minor, and Greece. His next expedition was into the interior of Africa, across the Sahara. About this journey he wrote a valuable work, which much extended his fame.

Another African traveller, Baron von der Decken, the recipient of one of the gold medals of the Royal Geographical Society, although it does not appear that he has lost, has run the risk of his life, and been exposed to great peril in his expedition from the Zanzibar coast up the river Juba. Separated from his party, through going in search of assistance in getting one of his steamers off certain rocks, he seems to have fallen into the hands of a Somāli chief. All who have resided on the Zanzibar coast, and have any knowledge of the interior, unite in declaring their conviction that the Baron will only be detained in order to secure a heavy ransom, and that his life is not in danger.* A fuller account of his position will be found further on.

The most active proceedings in the way of geographical research of which we have advices, are those of the Royal Engineers under Captain Wilson and Lieutenant Anderson in the Holy Land. A sum of 2,000*l.* has been assigned for this undertaking, which is to be carried on until April, after which the heat will not admit of further research. The route marked out for the intermediate period begins at Beyrout, and passes by way of Damascus to the source of the Jordan, continues the descent of that river, exploring various sites on the Lake of Gennesaret, and the lower valley of the Jordan, including Shiloh, Jezreel, Samaria, Bethel, and ending with the neighbourhood of Jerusalem. This expedition is intended to be preparatory for others in subsequent years, should money come in. The party have traversed as far as the centre of the western side of the Lake of Tiberias. Numerous astronomical observations have been recorded, and localities fixed; thus maps may become more trustworthy. Photographs have been taken of various important architectural remains; whilst plans, sketches, and drawings have been made of buildings, tombs, architectural ornaments, &c. In

* We have seen the report of his death since the above was written, whether it is trustworthy or not we cannot say.

many cases ruins have been excavated, and thus disputed points of topography have been settled. Inscriptions have been copied, or brought bodily away; and thus we may look forward to a flood of light being thrown upon many matters about which we are at present completely in the dark. Jewish, Phœnician, Assyrian, and Syrian antiquities will probably all receive some assistance from this expedition.

It is not alone in new, unknown, or even forgotten countries that geographical knowledge may be advanced. In almost the oldest of known countries we are acquiring information, as the last paragraph shows; in the most highly-civilized country of modern Europe something remains to be done. A M. Bourdaloue has brought before the Société de Géographie the importance and necessity of a general survey of France similar to our trigonometrical survey of Great Britain. The advantage of a work of this kind can hardly be exaggerated. For all matters of drainage, irrigation, and sanitary arrangements, it affords facilities, and it is indispensable for plans of extensive public benefit.

Whilst the Germans are preparing an expedition to the North Pole, to start next spring, towards which project the Prussian Government contributes a corvette of 200 horse-power and 9,000*l.*, a voice comes to us from the deep mists of the northern winter, speaking in mysterious sounds of some of the lost navigators of former expeditions. Captain F. C. Hall, who has already written a book about the habits of the Esquimaux from observations he made during an expedition in search of Sir John Franklin, writes word that in a second journey he has been told by those people, on whom he seems to rely more than northern travellers usually do, of the existence of Captain Crozier and two seamen. Very detailed and circumstantial stories of the loss of the ships, the destruction of others of their company, and the discovery of these men and of another who has since perished by disease, were given to the enthusiastic captain; but it does seem remarkable that, should they still be alive, they have never found means of communicating with any of the numerous parties that have travelled over their route, nor have been enabled to get within reach of any of the northern outposts of the Hudson's Bay Company. Until something more trustworthy is reported, it seems scarcely worth while pursuing such fleeting shadows as the Crozhar, Parme, and Pezart (Fisher) of the Esquimaux squaw.

We have already spoken of the German travellers in Africa, of the German expedition to the Pole, it remains to mention two important German works of Geography lately published: 'Journeys on the Upper Nile,' from the papers of W. von Harnier, with a Preface by Dr. Petermann, chiefly referring to the countries between Khartûm and Zanzibar; and Dr. Adolph Bartien's 'Peoples of

Eastern Asia—Studies and Journeys.' Besides these contributions to science, the Austrian Government is fitting out an East Asiatic expedition, making a very fair proportion of work from the German Fatherland.

Proceedings of the Royal Geographical Society.

At the fourth meeting of the Royal Geographical Society, M. P. B. Du Chaillu gave an account of his second expedition to Western Equatorial Africa. We have from time to time chronicled the proceedings of this traveller, but we will here give again a résumé of his doings. Leaving London on the 5th of August, 1863, he arrived the same autumn at the mouth of the Fernand Vaz River, where, owing to his having to land in a canoe, he lost all his scientific instruments, and was consequently compelled to wait a year for the arrival of new ones. In the meantime he made collections of objects of botanical and zoological interest, which were forwarded to England. On the arrival of fresh instruments he journeyed eastwards over a belt of flat country, and then gradually ascending ridges of hills, mostly covered with dense forests, and rising to the height of about 2,400 feet. He traversed the country of Ashira, Apinji, and Otondo, and was at last driven back by the natives, who attacked his cowardly men, because one of them had accidentally (?) shot two natives. His most remarkable discovery on this occasion was that of a race of dwarfs, some of whom appear to have been not more than four feet and a-half high. They were a nomadic, plundering race, something like our gipsies in their habits, and distinguished by short tufted hair. This account is astonishing enough, but we can only take what stories the traveller likes to tell us. In the disgraceful flight of his attendants, M. Du Chaillu lost his natural history collections and photographs, but succeeded in saving his chronometers, journals, and one set of very valuable astronomical observations.

M. Du Chaillu's veracity was warmly defended by Professor Owen, especially in reference to the gorilla, and a fish-eating, otter-like quadruped, the Potomogale velox, which latter animal had been classed by others as a rodent, but, as it turned out, without foundation. Mr. J. Crawfurd impugned the account of the dwarfs, but the traveller reiterated his assertion, and mentioned that he was able to examine only one or two specimens.

The next meeting was devoted to the discussion of subjects connected with Australia. The society had voted a sum of 200*l.* towards the expenses of the expedition in search of the relics of Leichhardt's party. This undertaking was commanded by Mr. Duncan McIntyre, who has already explored a route from Victoria to the Gulf of Carpentaria in the search for pastoral lands. The

explorations will be continued as long as means are forthcoming. The governments of Victoria, South Australia, and Queensland have given large grants of money, and subscriptions are asked in this country.

The locality of the last new settlement at Cape York, at the extreme north of Australia, was described in a paper by Mr. John Jardine, a police magistrate. The district is a peninsula of fifteen miles in length, almost divided from the mainland by the Kennedy River. The soil is fertile: a reddish loam with sand and blocks of sandstone. Horses, cattle, pigs, and goats flourish, but the climate is unfit for sheep. The rainy season lasts for four months during the hottest part of the year, the thermometer reaching 98° in the shade. During the rest of the year, from April to November, a S.W. wind blows a fresh breeze, and the heat averages from 80° to 85°. The climate is perfectly healthy, and the colony might become a sanatorium for invalids from China and India. Four tribes of aborigines inhabit the district.

Across the continent at its north-western corner lies the River Glenelg, discovered by Sir George (then Captain) Grey and Lieutenant Lushington in 1838. The mouth of this stream had never been determined until the expedition in which Mr. James Martin, M.B., took a part, and of which he gave an account in a paper before the society. The *débouchement* takes place into Doubtful Bay, from which the way leads by a difficult passage into George Water, a large expanse, into which numerous channels landward seem to run; but they all ended in a tangled mass of mangroves. After a search of six days the true channel of the river was found at the north-eastern end of the George Water. The party passed thence upward, through a rugged hilly country, which afterwards became more level. The extraordinary fall of the tide (28 feet) makes the navigation very difficult. The country is fertile, but unsuited for sheep.

The misfortunes of Baron von der Decken's expedition on the Juba River, in the east of Africa, engaged the attention of the society at its next meeting, to the exclusion of the paper on the exploration of the River Purûs, which was postponed to the next meeting. The Hanseatic Consul at Zanzibar reports that the Baron made seven months' preparation on that coast, and then commenced ascending the Juba River with two steamers, one of which was wrecked soon after the starting of the expedition. About a month after, the Baron arrived at Berdera, where some disagreement with a Somāli chief arose, which was afterwards settled. A few miles farther up the second vessel struck on some rocks and began to fill. The cargo was taken out and the Baron and Dr. Lusk returned to fetch assistance from Berdera. Three days later some natives from the last-mentioned town attacked the party

encamped by the river and killed two; the remainder embarked at the command of Baron von Schickh, the leader of the party in the camp, and descended the river with all speed in the injured vessel, leaving the Baron in the power of the Somāli chief. The former and present British Consuls at Zanzibar express their opinion that the Baron von der Decken is retained at Berdera only with a view to obtain a heavy ransom, and that he runs no risk of his life. The commander of the British squadron has received commands from the Admiralty to render all the assistance in his power towards aiding this British expedition. Baron von der Decken had intended to cross the unknown parts of eastern Africa, and to strike the Eastern head waters of the Nile.

After Africa and Australia, South America seems to offer the best field for ambitious geographers. In this continent the huge river Amazons affords a means of communication with the extreme limits of the interior, and a means of communication that is soon likely to be opened to all the world; the exclusive privilege granted to a Brazilian Steam Navigation Company being about to be withdrawn. This great river could not of course penetrate all parts of the interior; but it has been hoped that its tributaries might supply the wants of the principal channel. With a view of making this means of transit available to the people immediately to the east of the Andes, Mr. W. Chandless, M.A., has attempted to explore the River Purûs, a tributary of the Amazons, that has previously baffled native traders. He was entirely successful in tracing this stream from the parent river to its source, and discovered that it was not, what he had hoped it might prove, in connection with the Peruvian river, Madre de Dios, but that it ended two degrees farther north. The banks are completely shut in by impenetrable forest, so that in no part was a view of the neighbouring country obtained by Mr. Chandless and his boat's crew of Bolivian Indians, and the inhabitants at the upper extremity proved to be small tribes, who had held no communication with the semi-civilization below, and were consequently in the Stone Age. The course of the river is very tortuous, but unobstructed by rapids, and flows for 1,866 miles. After the reading of the paper which described Mr. Chandless's discoveries, the opinion was expressed by Mr. Bates that a river so tortuous, whose mouth was at a distance of 1,100 miles from the Atlantic, with such a small population on its banks, could never be made available for commerce. On the main stream steamers ply 3,100 miles from its mouth.

VII. GEOLOGY AND PALÆONTOLOGY.

(Including the Proceedings of the Geological Society.)

One of the most recent memoirs published by the Geological Survey of India is Dr. Ferdinand Stoliczka's descriptions of "Geological Sections across the Himalayan Mountains, from Wangtu Bridge on the River Sutlej to Sungdo on the Indus; with an Account of the Formations in Spiti, accompanied by a revision of all known Fossils from that District." The geology of India possesses an ever-increasing interest to all who care to inquire how far the structure of England is typical of that of far distant countries. Hitherto the progress of the Indian survey has been fertile in results showing the similarity of the formations in that country to those in Europe; it has also brought to light many highly interesting and curious points of difference, especially respecting the association of fossils, which in several cases has been shown to be very abnormal when measured by an English or even a European standard. The memoir now before us treats of the geological structure of the districts of Spiti and Rupshu, the latter being about 50 miles to the north of the former. The geographical position of these districts will be understood when we say that they lie about 100 miles north-east of Simla, and about 50 miles south-east of Ladak. The formations present in Spiti consist of a central Gneiss, Lower and Upper (?) Silurian, Carboniferous, Upper Trias, Lower and Middle Lias, Oolites of an uncertain horizon, Cretaceous strata with Rudistes, and fluviatile and lacustrine beds of recent date. In Rupshu occur Middle and Lower Lias, Rhætic, Triassic, and Carboniferous rocks, as well as certain Metamorphic schists and Gneiss, Epidote-, Diallage-, and Serpentine-rocks, and fluviatile and lacustrine deposits.

In giving a condensed notice of so extensive a memoir, we can only pretend to notice some few points of the greatest interest, and more especially the light thrown by Dr. Stoliczka on the question of the correlation of the strata on the northern and southern slopes of the Himalayas. The "Central Gneiss," as its name implies, seems to form the division between the two series of formations. It also appears that the metamorphic rocks of the southern slopes correspond in part with the Lower Silurian of the northern, the remaining strata of this division being also represented by similar rocks on the southern slope. The Upper (?) Silurian, Carboniferous, and Upper Triassic rocks appear to be equally represented on both sides; but, on the other hand, the Liassic, Oolitic, and Cretaceous strata of the northern slope are unrepresented on the southern, though they exist, at least partially, in the Punjab and farther to the south in Cutch. Another contrast is presented by the occurrence of strata on the southern side, apparently of the age of the Bunter sandstone, which seem to be altogether wanting on the

northern. These differences indicate to a great extent the important conclusion to which Dr. Stoliczka has arrived respecting the relation existing between the orographical and geological features, namely, that not one of the geological zones is *essentially* connected with the geographical or orographical ranges. Whether it may ultimately be possible to trace any connection of this kind is a question of great practical and theoretical interest, and we cordially agree with Dr. Stoliczka's concluding Anglo-German exclamation, "Large is still the field for geologists in India!"

The origin of prairies has recently formed the subject of three papers in the 'American Journal of Science,' by Prof. Winchell, Mr. Lesquereux, and Dr. Dana, in the order mentioned. Prof. Winchell believes that the prairies are of lacustrine origin and of post-glacial date, that all seeds contained in these lacustrine deposits would perish, and that the vegetation which afterwards appeared "was more likely to be herbaceous than arboreal," because the seeds must have been brought from distant regions. Mr. Lesquereux considers that the prairies were formed by a process of natural reclamation from the borders of lakes, mouths and banks of large rivers, and coasts of seas (freshwater and salt), and cites in illustration the cases of the Mississippi, Lake Michigan, &c. He thinks that the nature of the soil formed under these circumstances would be such as to favour only the growth of sedges and grasses; and he endeavours to show that his explanation will account for the existence of all known prairies and large flat tracts of land, including "the natural meadows of Holland," &c. Dr. Dana advances an explanation of a totally different nature, namely, that the absence of forests and presence of prairies are caused by the dryness of the climate, while conversely the presence of forests is caused by its moisture. Dr. Dana's facts are indisputable and generally received, for everyone acknowledges the intimate relation of the moisture of the climate to the existence of forests; the only question is, Which is the cause and which the effect? Experience has shown that the moisture of a climate may be increased by planting forests, and diminished by clearing them.

Dr. A. von Koenen has published descriptions of the Lower Oligocene fossils of Helmstädt, near Brunswick, in the last number (vol. xvii., part 3) of the 'Zeitschrift der deutschen geologischen Gesellschaft.' It appears that the author has found 122 species of Mollusca and six corals in that locality, making in all 128 species; of these 17 are peculiar to Helmstädt, and one (*Nautilus imperialis*) is but doubtfully determined. Of the remaining 110 species, 100 are known to occur in the Lower Oligocene strata of other localities, while only 31 have been found in true Upper Eocene beds, and nearly as many, namely 30 species, in Middle Eocene deposits. Of course Herr von Koenen, being a warm advocate of

Professor Beyrich's Oligocene division, makes use of this very marked result to urge the claim of the "Oligocene" to universal recognition as representing a period distinct from the Eocene. In a former chronicle * we have seen that Professor Reuss's investigations into the Foraminifera and Bryozoa do not support such a conclusion; but it is possible that this difference in the evidence yielded by these several classes of animals may be owing to the greater vertical range generally possessed by the more lowly organized animals. The practice of "counting heads" does not, however, find much favour amongst the more advanced palæontologists, and, as it seems to us, it can only be defended on the ground that, on a large scale, errors tend to neutralize one another. Dr. von Koenen has also omitted to reckon as Upper Eocene species those shells which have been found in Lower Oligocene and Middle Eocene deposits, and which therefore must have existed during the Upper Eocene period; that is, of course, unless the universally accepted principle that such is the case be false; if it be false, the *onus probandi* lies with him.

In the same number of the 'Zeitschrift' the late Dr. Oppel proposes the name "Tithonic Stage" for the strata known to us as Portland, Purbeck, and Wealden. This association under one name of the beds between the Neocomian and the Kimmeridge Clay will doubtless be useful in regions where the true freshwater Wealden and Purbeck beds do not exist; but it is very unlikely to be adopted in England.

M. Barrande continues to defend his "Colonies" with great vigour, and the third part of his 'Défense des Colonies' is a large volume in itself. In it he treats at great length of the two upper members of his "third fauna," being stages G and H; but the only point of general interest is the conclusion that the fauna of these strata is not more nearly related to that of the Devonian system than are the faunas of the higher zones of the Upper Silurian formation in other regions, while the connection of the lower stages of this "third fauna" with the Devonian system is closer than that of the higher divisions G and H. The question at issue between M. Barrande and his opponents is one of such complexity that we cannot attempt to discuss it; but it seems unfortunate that the term "colony" should be applied to a precursor of the main fauna, instead of to isolated branches given off by the parent.

The pages of the 'Reader' have for some time past been adorned by a desultory discussion on Mr. Croll's hypothesis, that the glacial submergence was a necessary result of the influence of the weight of the ice-sheet, which during the glacial period covered the northern parts of the globe, on the earth's centre of gravity. Mr. Croll assumes, for purposes of illustration, that the ice in Greenland

* 'Quarterly Journal of Science,' vol. i. p. 100.

and other Arctic regions during the glacial period was 7,000 feet thick, and that it gradually diminished in thickness towards the Equator. The specific gravity of the ice-sheet being taken to be to that of the earth as 1 to 7, this mass would "shift the centre of gravity of the earth 500 feet to the north of its former position, and as the ocean would accompany the centre, there would consequently be a submergence at the North Pole equal to 500 feet." Again, "At the time that the ice-sheet would be forming on the northern hemisphere, a sheet of equal size would be melting off the southern, and this of course would double the effect." This hypothesis is obviously based on the assumption which we have just given as the ultimate conclusion, and therefore rests on a most ingenious example of the fallacy popularly known as "arguing in a circle." Most of the geologists and physicists whose letters on the subject have appeared in the 'Reader,' have combated Mr. Croll's views on different grounds; but none of them appear to have seen that they were endeavouring to undermine a house which is supported only by its roof. If an additional proof of the fallacy of Mr. Croll's hypothesis be needed, it will be found in the fact stated in Mr. Godwin-Austen's paper, and noticed subsequently in this Chronicle, that the circumpolar submergence of the glacial period did not extend farther southwards than a line corresponding roughly with that of the Bristol Channel.

A third volume of M. Boucher de Perthes' now celebrated 'Antiquités Celtiques et Antédiluviennes' has recently been published; it contains an account of the discoveries made of late years in the Valley of the Somme, having reference to the antiquity of man, and it will doubtless be read with pleasure by those who take a lively interest in the questions discussed, the more especially as its author was the first to assert that the flint implements of the Somme Valley-gravels were a proof that man existed contemporaneously with the huge extinct mammifers of the Post-pliocene period.

'Die Steinkohlen Deutschland's und anderer Länder Europa's, ihre Natur, Lagerungs-Verhältnisse, Verbreitung, Geschichte, Statistik, und technische Verwendung,* von Dr. H. B. Geinitz, Dr. H. Fleck, and Dr. E. Hartig,' is, as may be inferred from its title, a work of the most comprehensive description. The first volume, being the Geology, by Dr. Geinitz, has just appeared, and forms a valuable work of reference on the German Coal-Fields. In this respect it will be useful; but its value would have been greatly enhanced had more been said about the coal-fields of other countries, and less detail given about those of Germany.

The 'Geological Magazine' commenced the year with a new

* 'The Coal of Germany and other European Countries; its Nature, Stratigraphical Relations, Distribution, History, Statistics, and Technical Uses.'

publisher, at an increased price, and with a considerable improvement in type, style, and general appearance. The articles have also been better than usual, and several deserve special notice. Undoubtedly the most important in the January number is the excellent paper by Mr. C. J. A. Meyer, 'On the Correlation of the Cretaceous Rocks of the South-east and West of England,' in which the author expresses the opinion that the various groups of strata occurring between the top of the "chalk with flints," and the base of the Atherfield clay, were all in turn "deposited beneath the same ocean without serious break or intermission between them," therefore he does not admit that there was a long lapse of time between the deposition of the Lower Greensand and that of the Gault. His views are very clearly illustrated by a most ingenious ideal section from Folkestone to Lyme Regis; and he guards against the possibility of any misconstruction, by observing that "the strictly horizontal arrangement of the groups of strata shown in the section, though true for short distances, is therefore probably incorrect for each and all of the groups, if traced throughout their utmost range, and must be regarded as merely an approximate arrangement; it being, probably, as true for sedimentary strata as for forms of life, that all originated at some given point, and that, consequently, their lateral extension can seldom be represented by a horizontal line."

In the same number, Mr. Etheridge gives a notice of the important discovery of a number of Labyrinthodont Amphibia in the coal-measures of Jarrow Colliery, Kilkenny, and states that Professor Huxley has determined them to belong to five genera, at least four of which are new. There is also a description of an interesting Crustacean—being the first known British species of *Æger*,—by the editor, Mr. H. Woodward; and a very readable article 'On the Raised Beach of Cantyre,' by Mr. Hull.

In the February number, Mr. Binney endeavours to prove, in a paper on the 'So-called Lower New Red Sandstones of Central Yorkshire,' that the said rocks are not of Permian age, but belong to the Millstone-grit series. Professor Owen gives a description of a new Sauroid fish (*Thlattodus suchoïdes*) from the Kimmeridge Clay of Norfolk. Mr. Searles Wood, jun., commences an article 'On the Structure of the Thames Valley and of its contained Deposits;' and Mr. D. Mackintosh makes a grand onslaught on the "atmospheric denudation" theory, in a paper entitled 'The Sea against Rain and Frost, or the Origin of Escarpments.' The author of this last paper expresses himself vigorously, even perhaps dogmatically; and says a great deal that is worth reading. He contends that the sea is not a levelling agent, that rain and frost are incapable of producing cliffs, that the débris under cliffs is of marine origin, the majority of the blocks and fragments found scattered under

them having fallen previously to the last emergence of the land, that rain is incapable of abrading hard rocks, and that it would be difficult to exaggerate the denuding power of the sea as a laterally operating and undermining agent. Much might be said for and against these assertions; but we will merely remark that Mr. Mackintosh seems unable to imagine that the action of surface-currents and waves would tend to plane down the surface of a gradually rising mass of land; indeed, the possibility of the bed of a sea or ocean ever having been subjected to such an action does not seem to have occurred to him, for he states that the assumption of "the subaërialists" that the sea tends to plane down the land "is at variance with the generally received principle of physical geography, that the bottom of the sea at any given time is as uneven as the dry land." If the upheaval of sea and ocean beds were always violent and sudden, Mr. Mackintosh would no doubt be right. Mr. Searles Wood's paper contains the enunciation of some important views and statements; but we must postpone their consideration until after the completion of the paper.

Proceedings of the Geological Society.

The very small number of the Society's journal that we have this quarter to notice, contains three or four papers of average importance. Mr. Godwin-Austen's paper 'On the Submerged Forest-beds of Porlock-bay' possesses, perhaps, the greatest interest for the English geologist, as the evidences of geological changes which these beds present are much more complete than those exhibited by the similar deposits in Bridgwater and Swansea bays; "besides which, they better serve to illustrate the nature and order of oscillations of small amount, which have taken place at times shortly antecedent to the present." The chronological sequence, and the nature of the deposits, are in descending order as follows:—(1) Shingle bank, (2) Marine silt, (3) Surface of plant-growth, (4) Freshwater mud-deposit, (5) Forest-growth, (6) Angular detritus. Collating Mr. Godwin-Austen's reading of the evidence, we have the following history of the more recent geological changes which have occurred in this neighbourhood. The Angular Detritus (6) was formed, when the land was at its highest relative level, by subaërial weathering of the rocks on the high ground, and the accumulation of the débris at lower levels during the Glacial Period, and contemporaneously with the deposition of the Boulder-clay in the more northern parts of Britain. On this detrital accumulation forest-trees grew, and attained a great age; the trees were then killed by the deposition of freshwater mud,—the result, probably, of a depression of the land. Water-plants grew on the nearly dry surface of this mud-deposit, on which the trees fell, and the land

was probably slightly upheaved; the area was then depressed below the sea-level, and sea-mud with shells of *Scrobicularia piperata* was deposited; again the land was upheaved, and the surface of the mud was converted into meadow. Lastly, a small depression of the surface caused the accumulation of the shingle-bank on the meadow-land. We have thus, in this paper, a beautiful example of the manner in which even the smallest oscillations of level may be traced, in comparatively insignificant deposits, by the practised geologist. But Mr. Godwin-Austen makes still further use of the evidence he has obtained. The Angular Detritus he finds to be the same as that which overlies many of the so-called "Raised Beaches," such as that between Braunton and Baggy Point; consequently, "in a modified sense," these sea-beds or raised beaches are Pre-glacial, or older than the period of deep surface-disintegration. This "modified sense" is really "homotaxis;" for the author observes that "just as the amount of northern depression increased from the south northwards, so the progress of that depression was in the contrary direction, or from north to south. The line of the Bristol Channel was nearly the limit of this submergence, and was the last reached." Respecting the age of the deposits above the Angular Detritus, and the value of the indications they afford, Mr. Godwin-Austen remarks, "that they belong to the time of our existing assemblage of animals and plants, that they indicate changes of small vertical amount, and are remarkably uniform."

In a former Chronicle,* we gave a sketch of Mr. Jamieson's ice-dam theory of the Parallel Roads of Glen Roy, and we have now to notice a paper by the Rev. R. Boog Watson in contravention of that theory, and in support of Mr. Robert Chambers's view of their marine origin, chiefly on the grounds that the sea has been on the spot and is capable of performing the work required. The author's main objections to the ice-dam theory are—(1) that terraces similar to the Parallel Roads, though less perfect, exist at all levels round our coasts, as well as inland, along every fjord in Norway, and across the whole of Sweden; (2) that there are several terraces, even in Lochaber, unconnected with any "col;" and (3) that to provide the mass of ice required for the dams, the relation always observed to exist between glaciers and the snow-field which feeds them, would have to be reversed; that is to say, the snow-field would be minute and the glaciers gigantic. Mr. Watson also contends that the ice-dam theory treats the Parallel Roads as something distinct from other terraces, whereas he considers them specifically the same, the Glen Roy Roads differing only in being more perfectly preserved. The absence of fossils from the Parallel Roads is admitted to be a difficulty in the way of the "Marine Theory;" but Mr. Watson explains it by showing that it "accords with the character of simi-

* 'Quarterly Journal of Science,' vol. i. p. 292.

larly-placed beds in every other locality, both in Scotland and in Scandinavia." Mr. Watson defends his position with great ability, and attacks his opponents with a considerable amount of force; and although we cannot ourselves accept his conclusions, we regret that his paper has not been published in full, as all the facts and arguments on both sides of the question should be made equally public.

Dr. Duncan's paper "On Impressions of Selenite in the Woolwich Beds and London Clay," treats of a very curious and little-understood subject, and will, we hope, prepare the way for more complete researches. The impressions have been formed by the decomposition of globular stellate groups of crystals of selenite, and Dr. Duncan discusses the different ways in which the selenite may have been formed and subsequently removed. To geologists, the most interesting point is the probability of the conclusion that "the formation of gypsum, and of its more durable replacing crystalline form, selenite, suggests the decomposition and destruction of organic remains, and the disappearance of these minerals is equivalent to the destruction of the evidence of the former existence of organisms;" consequently, "there is no reason why the purest clay-slate may not have been formed from a fossiliferous clay."

The next paper, by the Rev. O. Fisher, is remarkably ingenious, but very heterodox; it is entitled, "On the Relation of the Norwich or Fluvio-marine Crag to the Chillesford Clay or Loam." The Chillesford Clay has hitherto been considered to be either the equivalent of the Norwich Crag or a little more recent; but Mr. Fisher endeavours to prove that it underlies that deposit and overlies the "Mya-bed," which last stratum he considers to be the one to which should be referred the bed at Southwold, containing Mastodon and other Mammalia; therefore he considers that we ought not to hesitate to include the Chillesford Clay in the Norwich Crag series. The paper is well worth a careful reading, on account of the author having taken so much advantage of even the most minute circumstances to prove, either directly or inferentially, the truth of his conclusion; but that conclusion must appear to an "old-fashion" geologist at least a little improbable.

Captain Godwin-Austen's "Notes on the Carboniferous Rocks of the Valley of Kashmere" are valuable, on account of the sections which illustrate them, and of Mr. Davidson's descriptions and figures appended thereto. The Carboniferous formation may be traced all along the range of mountains on the north side of the Kashmere Valley; and where Mesozoic rocks occur, both in Kashmere and Thibet, they are underlain by strata of Carboniferous age. The Brachiopoda from Thibet determined by Mr. Davidson belong to six Carboniferous, two Jurassic, and two Cretaceous (?) species. Those from Kashmere are all Carboniferous, and number as many

as twenty-three species, including many of the common and widely-spread European and American species, together with a few which have not yet been noticed from other parts of the world, and which indicate that the Carboniferous rocks of Thibet, Kashmere, and the Punjab belong to one great formation. From the very scanty notes now published we presume that Captain Godwin-Austen's researches are as yet incomplete, as the abstracts of his communications to the Society already published led us to expect a much more complete memoir. We shall therefore defer examining the questions suggested by the facts already given, until we have the author's own interpretation of them before us.

At the Anniversary Meeting of the Society, held on February 16th, the Wollaston Gold Medal was awarded to Sir Charles Lyell, Bart., D.C.L., F.R.S., F.G.S., &c., in recognition of the highly important services he has rendered to the study of Geology by his various original works, and for the masterly and philosophic manner in which he has treated the subject, both in developing the principles and in expounding the elements on which the science is founded; and the balance of the proceeds of the Wollaston Donation Fund to Mr. Henry Woodward, F.G.S., F.Z.S., to assist him in carrying on his researches on the Fossil Crustacea.

MINING, MINERALOGY, AND METALLURGY.

The depressed state of metal mining in this country still continues. The causes which were named in the Chronicles of our last number are still in operation, nor does there appear any immediate prospect of improvement. The continuance of the war between Spain and Chili, and the declaration of war by Peru, must necessarily in a little time increase considerably the price of copper, and consequently the value of British copper ores. The copper miners of this country may therefore calculate ere long on receiving some returns to compensate them for the losses to which they have been exposed for some years. A very unfortunate, though happily an unusual, contest has sprung up between the copper miners and the managers of the Great Devon Consolidated Copper Mines, and some other mines in the neighbourhood. Angry feelings were so far shown, that it was felt necessary to call in the aid of the military. The questions—those of wages and time—are now, it is hoped, in progress of settlement by arbitration.

Lord Kinnaird has again brought his Metalliferous Mines Bill before the House of Lords. It has been considerably modified from the bill which his Lordship withdrew last session. Sir George Grey stated, in reply to a question asked in the House of Commons, that the Government intended to bring forward a bill for the better regulation of metalliferous mines.

In our last we referred to the discoveries of silver said to have been made in California. We said we should watch the result with much interest, and we have reasons now for placing our readers on their guard. The reports of some English engineers who have been sent out to examine the district are by no means satisfactory. For example, reports of the following description from Austin-Nevada are not encouraging:—"We are on the eve of bad times; rascality and bad management have been doing their evil work; owners of '*wild cat*' sold claims at high prices; hundreds of stamps will stand idle for months to come," &c., &c. One gentleman of eminence in his profession will shortly return to this country; from him we may expect reliable information. In our next we hope indeed to furnish a report on the wonderful "Silver-peak" and the adjoining argentiferous district.

The "Comité des Houillères Françaises," according to their annual custom, have just issued their "Situation de l'Industrie Houillère en 1865." From this publication we learn that the production of coal from the French collieries in all the Departments amounted to about ten millions and a-half English tons. The French received for consumption, in addition to their own produce, from

	Tons.
England	1,285,514
Belgium	3,136,790
Prussia	873,270

They also imported 651,930 tons of coke from these countries.

The American government have lately published a very important volume, showing the industrial resources of the United States and their commercial relations with foreign countries. From this we extract the following information respecting the coal produce of Eastern Pennsylvania and the bituminous coal trade of Maryland.

EASTERN PENNSYLVANIA—*Hard Anthracite.*

	Schuylkill, Tons.	Lehigh. Tons.	Pinegrove. Tons.	Shamokin. Tons.	Wyoming and Lackawanna. Tons.	Aggregate.
1860	3,234,844	1,821,674	145,181	201,108	3,114,162	8,316,969
1861	2,644,402	1,738,387	168,148	241,451	3,243,730	8,036,118
1862	3,286,330	1,278,801	209,851	241,642	3,291,037	8,307,661
1863	3,703,964	1,894,713	203,991	274,936	3,777,447	9,855,051
1864	3,763,874	2,053,506	204,000	333,478	4,083,053	10,437,911
1865	3,835,916	2,291,017	157,840	457,162	3,341,158	10,083,093

EASTERN PENNSYLVANIA.—*Semi-Anthracite and Bituminous.*

	Lykens Valley. Tons.	Treverton. Tons.	Broad Top. Tons.	Blossburg. Tons.	Barelay. Tons.	Aggregate. S. A. & Bt. Tons.
1860	176,274	90,448	187,853	97,571	27,718	579,868
1861	170,392	46,656	272,709	112,713	40,835	643,205
1862	177,121	63,223	333,606	179,334	52,779	806,063
1863	141,282	62,000	305,678	226,183	54,116	789,259
1864	129,973	66,000	386,645	353,124	62,010	997,752
1865	..	..	315,996	..	..	..

MARYLAND (*Cumberland*)—*Semi-Anthracite and Bituminous.*

	Tons.
1860	666,572
1861	269,674
1862	317,634
1863	748,345
1864	657,996
1865	522,356

SUMMARY OF 1864.

	Tons.
Eastern Pennsylvania—Hard Anthracite	10,437,911
„ Semi-Anthracite and Bituminous	997,752
Maryland (Cumberland)—Semi-Anthracite and Bituminous	657,996
	12,093,659
The other coal-producing States	2,500,000
Total Coal-produce of America	14,593,659

The Foreign Office has just issued a series of 'Reports received from Her Majesty's Secretaries of Embassy and Legation respecting Coal.' These Reports originated in a circular issued in 1865 by Earl Russell, and sent to all countries producing coal, or with whom England had any trade for coal, requiring—

1. A statement of the coal-fields actually worked, and the development in production.

2. A statement of the external trade of each country in coal.

3. The ratio in which each country draws its supplies from Great Britain.

Reports from twenty-eight countries have been furnished. An Appendix gives 'Extracts from Commercial Reports by Her Majesty's Consuls;' these are short, but nevertheless valuable notes respecting twenty-two places in various parts of the world producing coal or receiving British coal.

Such returns should possess considerable value. Unfortunately, the questions were committed to the care of a class of men, who, from their training, are entirely unfitted to answer them with any approach to correctness. The Secretaries of Embassy and Legation have never before been taxed with an inquiry such as this. They have consequently taken such information as came to their hands, and it is evident that they have not often troubled themselves to obtain the most recent. Austria, Prussia, and Belgium, for example, publish annually very complete returns of the mineral productions of each country. The returns for 1864 were very readily obtainable, yet 1862 is regarded as the most recent returns by the reporters. The American Government have lately published a valuable return, from which we have quoted; but the return of Mr. Burnley is almost entirely derived from Taylor's 'Statistics of Coal,' the latest edition of which was published in 1855, and that edition was little more than a reprint of a very much older book,

which has never been regarded as an authority, by those who had paid any attention to the important question of coal production. The errors in this book of Reports presented to both Houses of Parliament are curious and serious. We are gravely told that "an eminent geologist estimates the average thickness of the workable coal of Great Britain at thirty-five feet, and the total quantity of workable coal at 190,000,000 tons." This is bad news for us. Seeing that we are now obtaining from our collieries about 95,000,000 tons per annum, we have but two years' supply. Of Russia it is said, "There is, perhaps, no country in Europe where such *large* coal districts exist as in Russia." The truth is, there is no country in Europe, of such large extent, where such *small* coal districts exist.

As the Reports are intended for English readers, it is to be regretted that some uniform weight has not been adopted. Instead of this we have the weight in use in each country given, and in many instances without any explanatory note. We have Zollverein cwts., centners, metrical quintals, Prussian tonnen, Swiss "colliers" and half-mudden, continually perplexing us. Much valuable matter is to be gleaned out of the mass; and if the Secretaries of Legation are properly instructed as to the kind of return which they will be expected to make in future years, these Reports on coal may have a permanent commercial value.

Mr. St. John V. Day, of Glasgow, reports that the Rankinstone shale yields of crude paraffin oil thirty gallons, and of ammoniacal liquor twelve gallons, from the ton of shale. Several other shales in Fifeshire—the West Calder district and other places—have been examined with similar results. In Northamptonshire it has been found that the cannel coal of Hucknal Forehard Colliery gives forty-three gallons of crude oil to the ton. Extensive works are, in consequence, being erected.

We learn from the Australian newspapers that a substance resembling cannel coal has been found at Hartley and Wollongong, in New South Wales, and that a company has been formed for the manufacture of oil from it. It is stated that this cannel coal yields 147 gallons of oil to the ton; but we are not informed whether this is crude or refined oil. We of course infer the former. The question then arises, What is the value of this crude material for refined oil?

While writing this a report comes to our hands from Julius W. Adams, Engineer, Broadway, New York, on the principles and methods used by Mr. Simon Stevens for burning petroleum and other hydrocarbons in combination with jets of steam. The result, as given, is that 29·33 pounds weight of water at a temperature of 60° will be converted into steam by the combustion of one pound of oil; whereas it is said 8·16 pounds only of water at 60° can be

converted into steam of atmospheric pressure by one pound of anthracite coal. This of course requires confirmation by a continuance of the experiments. It must, however, be admitted that Mr. Richardson's experiments in this country were satisfactory.

Nitroglycerine has been much lauded as an explosive agent for mining purposes. It is now stated* that it freezes at a temperature of about 42° Fahr., when mere friction will occasion it to explode. In one of the Silesian mines an overseer was attempting to break a frozen mass, weighing about eight pounds, when it exploded, and the poor man was blown high into the air, and, of course, killed.

M. Simon communicates in a letter to M. Élie de Beaumont some interesting particulars respecting the Stanniferous deposits of Brittany. The district of Villeder consists of a system of quartz veins in contact with granites and schistose rocks, the direction of the principal veins being N.N.E. Penestin (in Breton *Pen-staen*, the Headland of Tin), Piriac, and Morbihan are all tin-producing districts, and it is thought that the embouchures of the Vilaine and the Loire were visited by Phœnicians and the Greeks in the time of Homer. To these points M. Simon would call the attention of modern tin miners, especially as the districts correspond with the rich tin-bearing districts of Cornwall.†

Mineralogy.

Knop has recently discovered in the decomposed and weathered cryolite a new mineral, to which he has given the name *Pachnolite*, from its resemblance to hoar-frost. Knop gives the chemical composition as Fl. 50·79, Al. 13·14, Na. 12·16, Ca. 17·25, H. 9·60= 102·94.‡ Dr. G. Hagemann, of the Alkali works at Natrona, in Pennsylvania, has examined this mineral, and he fully confirms M. Knop's results. It appears that cryolite is now imported largely to Natrona from Greenland, for the purpose of manufacturing soda-ash, alumina salts, and other products.§

Professor W. P. Blake states that a mass of gold, which is for the most part a congeries of imperfect crystals, has been found seven miles from Georgetown, El Dorado Co., California, which weighs 201 ounces.‖

The amount of gold and silver produced in 1865, from the mines of the Montana Territory, will be sixteen millions of dollars. The region was a wilderness in 1862.¶

An iron ore of peculiar character has been discovered in Ireland. It has much the appearance of Plumbago, leaving a greasy stain when rubbed between the fingers, and giving off under the knife

* 'Berg und Hütten-mannische Zeitung.'
† 'L'Institut,' Feb. 21, 1866. No. 1677.
‡ 'Annalen der Chemie und Pharmacie,' vol. cxxvii.
§ 'American Journal of Science and Arts,' Jan., 1866.
‖ Ibid. ¶ Ibid.

glistening particles of a metallic lustre, not unlike mica. It was unacted on by the blow-pipe, and contained no carbonaceous matter. Its composition was stated, at a meeting of the Geological Society of Glasgow, to be—Ferric oxide 90·5, Insoluble matter in HCl and NO_5 9·5=100. This was, without doubt, a peculiar variety of micaceous iron ore.

Dr. Tschermak's "Researches on the Group of Felspars," referred to in our last number, have called forth a paper by Professor Rammelsberg, "On the Composition of Oligoclase and Labradorite, &c." (Ueber die Zusammensetzung von Oligoklas und Labrador, &c.).* Although the different members of the felspar family consist of double silicates, which invariably contain one atom of protoxide to one atom of alumina; or, in other words, in which the oxygen of the protoxide bears to that of the sesquioxide the constant ratio of 1:3, yet there probably exists no felspar which contains only a single protoxide. Thus in ordinary orthoclase-felspar, the potash is always accompanied by soda, which sometimes reaches so high a percentage that certain forms of sanadine or glassy felspar contain as much as one atom of soda to one of potash; and the same is the case with the orthoclase from the Norwegian zircon-syenite. These soda-bearing potash-felspars are probably to be regarded as regular associations of orthoclase and albite; such, at least, is certainly the case with the mineral called Perthite. Extending this idea, Tschermak supposed that the existence of soda in *all* potash-felspars was referable to the presence of associated albite, as proved by analysis; but Rammelsberg objects that this is a point which can be determined, not by chemical analysis, but only by physical research; and that this has hitherto failed to prove the existence of albite in such compounds. Thus, according to Rammelsberg's own analysis, the glassy felspar from the trachyte of the Drachenfels on the Rhine, contains 10·32 per cent. of potash, and 3·42 of soda, corresponding to 57 per cent. of orthoclase and 43 of albite; the mineral thus consisting, according to Tschermak's theory, of one atom of albite and two of orthoclase: yet this mixed felspar, in which albite forms no less than one-third of the mass, in nowise differs, either in crystalline form or in optical properties, from the purest adularia. Such cases might, however, be explained by regarding the mineral as an isomorphous combination of potash-orthoclase with a soda-orthoclase unknown in an isolated form, but which evidently must be a monoclinic compound, and not a triclinic albite.

Rammelsberg regards as equally inconclusive Tschermak's explanation of the presence of potash in albite, and of potash and soda in anorthite; physical observation having shown that orthoclase is not present in albite, nor othoclase and albite in anorthite.

* 'Poggendorff's Annalen,' 1865. No. 9.

Passing to the other felspars—Oligoclase, Labradorite, Andesine, &c.—the author agrees with Tschermak in regarding these different forms of soda-lime felspar as isomorphous compounds of anorthite and albite in definite proportions—a conclusion at which Rammelsberg arrives by an elaborate tabulation of a very extensive series of analyses, and which is corroborated by certain crystallographic considerations.

At the conclusion of this paper we are reminded that the idea of regarding the middle terms of the felspar series as mixtures of the two extremes, is an idea which by no means originated with Tschermak, but which has been worked out in different ways by Waltershausen, Hermann, and others.

To the same number of 'Poggendorff's Annalen,' Herr Schmid contributes three mineralogical papers. The object of the first of these is to correct the formula established by Von Kobell, for the hydrous silicate of lime called *Okenite*, and which is always expressed as $3\ CaO, 4\ SiO_3 + 6\ HO$. The author shows that one-sixth of the water present is simply hygroscopic, and may therefore be expelled at ordinary temperatures; and that a second atom may be driven off at a higher temperature, and may hence be compared to "water of crystallization;" the remaining four atoms being true "water of combination," essential to the constitution of the mineral. These three conditions of Okenite may be thus represented:—

(1.) $3\ CaO, 4\ SiO_3 + 6\ HO$
(2.) $3\ CaO, 4\ SiO_3 + 5\ HO$
(3.) $3\ CaO, 4\ SiO_3 + 4\ HO$

In the second paper, Herr Schmid describes the aragonite from the Zechstein of Kammsdorf, near Saalfeld in Thuringia. The mineral occurs in small bundles of diverging crystals, locally called "needle spar" (Nadelspath); the crystals often presenting twin forms, and when colourless consisting simply of carbonate of lime with the merest trace of magnesia. This aragonite is interesting as a dimorphic form of *pure* calcic carbonate, the entire absence of strontia and baryta—constituents commonly present in this mineral—having been determined by spectrum analysis.

The examination of three varieties of psilomelane forms the subject of the third paper, and leads the author to adopt for this unsatisfactory species the formula of $(MnO, BaO), 4\ MnO_3 + 6\ HO$.

Dr. F. Wibel has written an interesting paper on "The Alteration-Products of Ancient Bronzes: a Contribution to the Origin of certain Copper Ores, especially the Red Oxide" ("Die Umwandlungs-Produkte alter Bronzen: ein Beitrag zur Genesis einiger Kupfererze insbesondere des Kupferoxyduls").† The green coating of cupreous

* 'Ueber Okenit;' 'Ueber den Aragonit von Gross-Kammsdorf bei Saalfeld;' and 'Ueber Psilomelan.'

† 'Jahrbuch für Mineralogie,' &c., 1865. 4 Heft.

carbonate, exhibited in a greater or less degree by all old bronzes, and which is well known to antiquaries as *patina*, is often accompanied by suboxide of copper, occurring usually in small octohedral crystals, greatly resembling those of the native mineral. This suboxide is generally in immediate contact with the metal, and therefore beneath the external coating of carbonate—a disposition with which the mineralogist is familiar, as occurring in certain specimens from copper lodes, which exhibit a nucleus of native copper surrounded by red oxide, and this again by malachite. Both the natural and the artificial specimens are commonly supposed to have been formed by the action of atmospheric influences on the metal, producing first an oxide, and finally a carbonate; both being regarded as products of oxidation. From carefully conducted observations on ancient bronzes, the author is enabled to oppose this commonly received opinion, and to show that the red oxide of copper, so far from being a product of oxidation, is, in truth, a product of reduction. By the action of water charged with oxygen, carbonic acid, and various salts, there are first formed upon the bronzes certain soluble cupreous salts, which afterwards suffer reduction, either partially to the condition of suboxide, or completely to that of metallic copper.

Some valuable chemico-mineralogical views are set forth by Dr. Streng in an able memoir "On the Composition of certain Silicates, with especial reference to Polymeric Isomorphism" ("Ueber die Zusammensetzung einiger Silicate mit besonderer Berücksichtigung der polymeren Isomorphie"). Without crowding our pages with what Dr. Hofmann aptly enough terms the "Algebra of Chemistry," it would be impossible to explain Dr. Streng's views.

The mineral *orthite*—a silicate of alumina, protoxide of cerium—has been recently discovered by Sandberger at Dürrmosbach, near Aschaffenburg, in the Spessart.* It occurs in brownish-black lustrous granules or crystalline fragments in an anorthic felspar, thus presenting another example of the association of cerium-bearing minerals with lime-and-soda felspars.

In the Italian section of the International Exhibition was a specimen of "fine siliceous sand," occurring on the shore of the Adriatic, near Pesaro, where it is used for cutting hard stones, sawing marble, &c. This sand has been examined by M. Pisani,† who finds it to be garnetiferous. Granules of magnetic iron ore having been removed by the magnet, and carbonate of lime dissolved out by hydrochloric acid, the residue consists chiefly of rose-coloured grains, which are proved by analysis to be true garnet of the variety called almandine.

* 'Orthit im Spessart.' 'Würzburger Naturwissenschaftliche Zeitschrift,' 6 Band, 1 Heft, p. 43.

† 'Sable granatifère de Pesaro; Thulite de Traversella: Bustamite du Vicentin.' 'Comptes Rendus,' No. 2, 1866.

The pink epidote known as *thulite* is described by Pisani from near Traversella, in Piedmont, where it occurs in small veins, associated with talc and green hornblende in a granite rock.

The same chemist also announces a new locality for the rare mineral *Bustamite*, a silicate of manganese, containing lime, hitherto found only in Mexico. The specimen analysed by Pisani came from Monte Civillina, between Schio and Valdagno, in Italy.

A visit to the locality of the aluminium ore *Bauxite* has enabled M. Virlet d'Aoust to present to the Geological Society of France certain "Mineralogical and Geological Notes on the Pisolitic Aluminous Iron Ore of Mouriès, called also Les Baux" ("Notes Minéralogiques et Géologiques sur le Minerail de fer Alumineux Pisolithique de Mouriès, dit aussi des Baux").*

Professor Maskelyne announces† that he has received from Mr. Talling, of Lostwithiel, a new Cornish mineral, described as a finely-granular greenish-blue substance, which proved on analysis to be "a hydrated aluminic (with traces of calcic) silicate, tinted rather deeply with a cupric silicate. It is doubtless an opal allophane, the Saltzburg variety of which mineral it closely resembles."

The literature of mineralogy has been recently enriched by the publication of the first volume of an admirable 'Treatise on Physical Mineralogy,' by Dr. Albrecht Schrauf, of Vienna.‡ The present volume—devoted exclusively to Crystallography and Mineral-Morphology—contains an interesting outline of the history of Crystallography and Crystallogenesis, followed by several chapters on Homœomorphism and Pseudomorphism. Considerable space is then devoted to Theoretical Crystallography, the system adopted being that of Miller and Neumann, with certain modifications introduced by the author. The different forms of goniometer are then described, and ample instructions given both for taking measurements and for reckoning the results. At the close of the volume is a useful table giving a comparative view of the crystallographic symbols of different authors. The present work is intended as a companion to the author's 'Atlas der Krystall-formen des Mineralreiches,' an elaborate work, to be completed in twenty parts, of which the first appeared a few months ago, comprising ten beautifully executed plates of crystalline forms. In these comprehensive works Dr. Schrauf appears to be doing for Physical Mineralogy what Rammelsberg has already done for the Chemistry of the Science.

Metallurgy.

In the Proceedings of the American Academy we find a claim put forward by Professor Asa Gray, in favour of Professor Tread-

* 'Bulletin de la Société Géologique de France,' 2nd Series, vol. xxi'. p. 418.

† 'Chemical News,' Feb. 16, 1866.

‡ 'Lehrbuch der Physikalischen Mineralogie,' von Dr. Albrecht Schrauf. 1. Band. 'Lehrbuch der Krystallographie und Mineral-Morphologie.' Wien, 1866.

well, as being the inventor of the so-called "built-up guns," and for which the Academy awarded him their Rumford medal.

Professor Gray quotes Professor Treadwell's own language: he says, "Between 1841 and 1845 I made upwards of twenty cannon of this material (wrought iron). They were all made up of rings, or short hollow cylinders, welded together endwise; each ring was made of bars wound upon an arbor spirally, like winding a ribbon upon a block, and, being welded and shaped in dies, were joined endwise when in the furnace, at a welding heat, and afterwards pressed together in a mould by a hydrostatic press of 1,000 tons force." This and sundry other matters bearing on this question are stated to have been published in 1845, and that a French translation of the pamphlet was published in Paris in 1848 by a Professor in the School of Artillery at Vincennes.

We feel assured that Sir William Armstrong will not dispute Professor Treadwell's claim. The manufacture of "built-up guns" is very much older than the American Professor. We have in Edinburgh "Mons Meg" as an example, and similar guns which were used at the siege of Calais are still preserved, and gun-barrels have long been made in this way. Professor Asa Gray repeatedly contrasts Professor Treadwell's gun with Sir William Armstrong's, failing, apparently, to see that the "coiled cylinders" are only a part, and a very small part, of the arrangements adopted in the construction of the Armstrong gun. No doubt Professor Treadwell's guns are of a high character, and he fully deserves the encomiums passed upon him on the delivery of the medal.

Mr. Mosheimer, who was for a long time connected with the gold mines in North Wales, is now engaged in experiments with the sodium process of Mr. Crookes in California. He gives the following statement of the results of his experiments:—"I worked the same ore, side by side, with the same machinery, and the results were as follows:—*First lot* of 500 lbs. Each pan with sodium yielded 85 per cent. of the assay; without sodium the yield was only 55 per cent. *Second lot*—different ore—with sodium, 80 per cent.; without sodium, 60 per cent. *Third lot*—different ore—with sodium, 78 per cent.; without sodium, 60 per cent." We make no comment on these results.

Mr. E. H. Newby, of London, has patented a process for increasing the strength of iron, and rendering it less liable to corrosion. It is, at all events, curious enough to be recorded, whatever may be its value. Twenty-five pounds of zinc, two-and-a-half pounds of tin, five pounds of copper, and one-fifth of a pound of aluminium, with two pounds of borax, and one pound of the permanganate of potash, are first melted together; then a thousand pounds of "white iron" are gradually added, and the whole incorporated. The resulting iron is said to be "very strong and pliable, and little liable to

be corroded by acids." The metallurgical chemist will be rather puzzled to determine which of the agents in the alloy is the most effective.

Mr. F. Claudet proposed to economize the oxide of iron resulting from the decomposition of the cupreous pyrites, as practised at Mostyn, at Newcastle, and other places, by moulding it into bricks by means of plaster of Paris. These, after they have been dried, can be used in the blast furnace as any ordinary iron ore.

M. H. Caron has a clever paper, in a recent number of 'Les Mondes,' on blistered steel, in which he gives the results of his experiments and observations. He is disposed to refer the formation of these blisters to carbonic oxide, but he admits the necessity of a more extensive series of experiments.

The Managing Director of the Bolton Iron and Steel Company writes us as follows:—"In your January number for this year you publish a statement illustrative of the powers of modern metallurgy, and after describing the large 'block of steel' cast at Messrs. Bessemer & Sons' works at East Greenwich, you go on to say that 'large as this block is, it was far exceeded by what has been done at Bolton by the "aid of" Messrs. Ireland & Sons' patent upper twyer cupola furnaces, where a block of steel weighing 250 tons was cast. This furnace melts at the rate of thirteen tons of Bessemer steel in an hour,' &c., &c. As managing partner of the Bolton Iron and Steel Co.'s works, I think it my duty to correct this statement; and without wishing to detract in the least from the value of Messrs. Ireland & Sons' patent cupolas, which did their work in a most satisfactory manner on the occasion alluded to, I may state that the block in question is one of four which Mr. Ireland cast at these works, but it is of iron and not steel, and the weight is something over 205 tons. A small quantity of Bessemer steel scrap was melted down along with the pig-iron, in place of putting in cold blast iron, and the time occupied in casting the block was ten hours from the blast being put on to the cupolas, including the stoppages necessary for the workmen to take refreshment. I believe the block cast at Messrs. Bessemer & Sons' works was entirely of iron."

IX. PHYSICS.

Light.—The Academy of Sciences have bestowed the Bordin Prize of 1,500 francs upon M. Janssen for a memoir "On the Terrestrial Lines of the Solar Spectrum." The following abstract of the memoir will show the author's line of research:—Sir David Brewster many years ago discovered in the solar spectrum certain dark bands which become more and more marked as the sun

descends towards the horizon. These bands, considered as to their real constitution and origin, have been the subject of long and persevering researches by the author, the principal results of which are contained in the memoir submitted. The bands have been resolved into fine and well-defined lines, visible in different degrees at all heights of the sun. A variety of proofs allow of distinguishing with much probability these particular or *telluric* lines from the lines pre-existing in solar light. Lastly, if the whole of these lines appear to have the terrestrial atmosphere for a common origin, a certain number of them would appear to be caused by the presence of the vapour of water in the atmosphere. The memoir gives a special account of the author's experiments on the Faulhorn—that is to say, at a height of 2,683 mètres—where he found that these telluric lines were much less visible than in the plain. It contains also an account of an experiment made at Geneva, which seems to show more conclusively that the cause of these lines resides in the atmosphere. The author made a large bonfire at night, and examined the light first close by, and then at a distance of twenty-one kilomètres. In the first case the spectrum remained continuous; but at the distance just mentioned the telluric lines were clearly seen.

In a memoir by M. J. Nicklés, "On the Effects of Colouration and the Extinction of Colours produced by Artificial Lights," the author has suggested a good lecture experiment. With the following pigments he paints a spectrum, which shows all the colours either by gas or candlelight, but shows only black and white with a soda flame (alcohol and salt).

Colour by daylight.	Pigment.	Colour by Soda flame.
Red	Ochre	Black.
Orange	Biniodide of mercury	White.
Yellow	Chromate of lead	
Green	Manganate of baryta	Black.
Blue	Aniline blue	

At a recent meeting of the Chemical Society, Mr. C. R. Wright read a paper, entitled "Contributions to our Knowledge of the Chemical Action of Sunlight upon Sensitive Photographic Papers." Following the method adopted by Mr. McDougall, and described in his paper ('Journal of the Chemical Society,' vol. iii., p. 183), the author proposed to determine the relative degrees of sensitiveness exhibited by papers coated with the chloride, bromide, and iodide of silver, and mixtures of these, in the proportion of single equivalents, in the presence of a constant excess of nitrate of silver. The conclusions established by the author's experiments are stated in the form of eight propositions; but the general nature of the results may be gathered from the subjoined table, which describes the rela-

tive degrees of sensitiveness observed when the several papers were referred to a normal tint; thus:—

Chloride of silver paper	1000
Chloro-iodide of silver	1078
Chloro-bromide of silver	4022
Bromide of silver	2396
Bromo-iodide of silver	4060

M. Poitevin has lately succeeded in producing photographs on paper in their natural colours. He prepares his sensitive paper in the following way:—Having obtained a layer of violet subchloride of silver on the paper, by the action of light on the white chloride in the presence of a reducing agent, he applies to the surface of the paper a liquid composed of one volume of a saturated solution of bichromate of potash, one volume of saturated solution of sulphate of copper, and one volume of a solution containing five per cent. of chloride of potassium. This paper is dried and kept in the dark; it will keep good for several days. In this mixture the bichromate of potash is the principal agent, the sulphate of copper facilitates the action, and the chloride of potassium preserves the whites which are formed. In copying paintings on glass, the exposure to direct light need only last five or six minutes; but the time must, to some extent, depend on the transparency of the picture to be copied, and it is easy to watch the development of the image on the paper. The paper is not sufficiently sensitive for use in the camera. To preserve the pictures it is only necessary, first, to wash them with water acidulated with chromic acid, then to treat them with water containing bichloride of mercury, afterwards with a solution of nitrate of lead; and, lastly, well wash them with water. After that they will not change in ordinary light, but will, however, turn brown in direct sunlight.

In order to prepare a window for the illumination of a photographer's dark-room, Obernetter mixes an acid solution of sulphate of quinine with some gum or dextrine, and paints the mixture over a thin sheet of white paper. With this he covers the window-panes, and he states, that on the brightest day a window so prepared will allow no actinic light to pass. This we doubt. The strongest solution of sulphate of quinine allows some of the photographic rays of light to pass through, and it is not likely that paper coated with the salt would be more impervious to the actinic rays than the solution itself.

The micro-spectroscope has received its first application to medico-legal purposes in the examination for blood-stains of the hatchet supposed to have been used in the Aberdare murder. Dr. Bird Herapath, F.R.S., who was retained by the Crown, placed sections of the handle in distilled water, and submitted the solution

obtained to an examination in this instrument. Within the green and on the border of the yellow rays, the well-known characteristic dark bands of blood were produced. Only one other substance was known to produce similar dark bands—cochineal dissolved in ammonia—in which case, however, their position would be different. Dr. Herapath said he was satisfied from the evidence this test had afforded, that the hatchet had been stained with blood.

HEAT.—An important paper by Professor Tyndall has lately been presented to the Royal Society. It is divided into ten sections. In the first, the experiments of Sir William Herschel and of Professor Müller, on the sun's radiation, are described. In the second are given a series of measurements, which show the distribution of heat in the spectrum of the electric light. In the third section is described a mode of filtering the composite radiation of an intensely luminous source, so as to detach the luminous from the non-luminous portion of the emission. The ratio of the visible to the invisible radiation determined in this way is compared and found coincident with the results of prismatic analysis. The eminent fitness of a combination of iodine and bisulphide of carbon as a *ray-filter* is illustrated. In the fourth section, experiments with other substances are described; various effects obtained in the earlier experiments on the invisible rays being mentioned. In the fifth section, the absolutely invisible character of the radiation is established: it is also proved that no extra-violet rays are to be found at the obscure focus. Numerous experiments on combustion are also described in the fifth section. The sixth section deals with the subject of *calorescence*, or the conversion of obscure radiant heat into light. In section seven, various modes of experimenting are described, by which the danger incident to the use of so inflammable a body as the bisulphide of carbon may be avoided. In the eighth section are described experiments on the invisible radiation of the lime-light and of the sun. In the ninth section, the effect obtained by exposing papers of different colours at the dark focus are mentioned; while the tenth and concluding section deals with the calorescence obtainable from rays transmitted by glasses of various kinds.

In a subsequent paper on radiation and absorption, Professor Tyndall considers the department of certain additional elementary bodies towards radiant heat. He exposes powders and liquids of the same physical character, but differing from each other chemically, at a focus of dark rays, and describes the different effects produced. He examines and explains the experiments of Franklin on the absorption of solar heat. He then determines the radiating power of a great number of substances in the state of fine powder, and finds, contrary to the current belief, that in this state also chemical

constitution exercises a paramount influence. The results obtained by previous experimenters in connection with this subject are illustrated and explained. The reciprocity of radiation and absorption on the part of fine powders is also illustrated. It is, moreover, shown that the heat emitted from different sources, at a temperature of 1,000° C., varies in quality, this being proved by its unequal transmission through plates of rock salt of perfect purity. The absorption by such plates varies from 4 to 30 per cent. of the incident radiation.

Magnus has published a memoir "On the Difference between the Heat Radiated from Polished and Unpolished Surfaces." The author has made the important observation that a plate of platinum covered with platinum black radiated twice as much heat as a plate of polished platinum of equal extent; and on analyzing the radiations he discovered that the increase of heat from the unpolished metal is not due to a regular increase in all the rays emitted, but that the red, and especially the ultra-red, rays are chiefly augmented in intensity. The whole paper is of great interest, especially the author's final considerations on the identity of heat and light.

A notice of an interesting property of sulphocyanide of ammonium has been published by Mr. F. Clowes. He finds that when dissolved in water this salt produces intense cold; in a short time the atmospheric moisture being deposited like hoar-frost on the sides of the vessel.

This led him to try a few experiments with weighed quantities of water and of the salt; from a few trials with different proportions, it appeared that the mixture of equal parts by weight gave the most intense cold. By mixing 1,368 grains of the salt with its weight of water at 17° C., a cold of —12° C. was obtained; the temperature of the atmosphere at the time of the experiment was the same as that of the water employed.

Electricity.—A very interesting experiment has been described by M. Cauderay. He introduces an electro-magnet into the circuit of a galvanic pile, and, breaking the circuit at any point, places the ends of the two conducting wires, separated one from the other, in a box containing metallic filings, such as silver, copper, brass, or iron. The metallic particles will of course complete the circuit. If, now, one of the conducting wires be slowly raised, a small chain, formed by the juxtaposition of the metallic particles, will be drawn out, and if the experiment be made with great care, every particle in the box can be drawn out in one long chain. The author states his opinion that the adhesion of the particles is not due to magnetization, but is the result of a sort of autogenous soldering by a superficial fusion of the metallic particles. The same author has shown that metallic filings offer very great resistance to currents of

dynamic electricity, and upon this principle constructs a new and very cheap rheostat.

M. Hempel has noticed a curious fact respecting the electric conductibility of hyponitric acid. He states that with a powerful machine in full activity and giving strong sparks, the sparks cease and the machine loses all its tension if a vessel containing nitric acid and some copper-turnings be placed so that the red vapours of hyponitric acid may escape into the space traversed by the spark. The tension of the machine reappears as soon as the vessel is removed and the red cloud has been dissipated. To succeed well with this experiment it must be made in a dry atmosphere, or nitric acid will be produced.

Mr. G. Jean has, by means of electricity, succeeded in the splitting up of carbonic acid into ozonised oxygen and carbonic oxide. The author employs an induction coil, provided with a peculiar condenser, for dividing the spark into an infinite number of very feeble sparks. By this apparatus, he says, he proves that carbonic acid, under the influence of the sparks, splits up into carbonic oxide and oxygen; and the odour and other tests showed that the oxygen is strongly ozonised. Atmospheric air exposed to the same influence becomes ozonised, and forms nitric acid (?), which suddenly decomposes into nitrous acid when the air is heated. Ozonised oxygen, the author says, has the property of giving rise to vapours when mixed with sulphurous or nitrous acids, and these vapours are very persistent in the presence of ammonia and iodine. Crystals of iodine dropped into a vessel of ozonised oxygen also gives rise to a very thick vapour, which gradually precipitates in the form of iodic acid. A coating of linseed oil on glass exposed to ozonised oxygen became dry in an hour, and its weight was found to have increased by 20 per cent. The quantity actually absorbed, the author stated, must have been much more considerable, for it was disengaged in the form of strongly-smelling acid vapours.

A paper "On Deaths by Lightning and their Division between the Sexes" has been communicated to the Academy of Sciences by M. Boudin. In a former paper the author showed that more men than women were killed by lightning in France. He now adds statistics for 1864, in which year 87 people were killed, 61 males and 26 females. Putting together his figures, and making a guess for the three new departments, he calculates that in the period of thirty years there have been in the France of to-day 2,431 deaths by lightning. He adds, that the total number of individuals injured is at least four times that of the number killed outright. Thus, the whole number struck from 1835 to 1864 inclusive must have been 12,000, or 400 a year. From 1854 to 1864 inclusive, 967 people were killed in France, 698 being males, and 269 being

females. The females, therefore, only constitute 28 per cent. of the victims. In England, M. Boudin adds, the proportion of females is even lower, being only 22 per cent. Referring to the circumstance that when lightning has struck a group composed of individuals of both sexes, the men have been killed and the women escaped, M. Boudin is at a loss how to account for this comparative immunity of the female sex. The 'Chemical News,' commenting on the above paper, suggests that a ready explanation is to be found in the fact that men are, on the average, taller than women.

X. ZOOLOGY AND ANIMAL PHYSIOLOGY.

One of the most important facts which we have to chronicle this quarter in relation to zoological science is the formation of the new chair of Comparative Anatomy and Zoology in the University of Cambridge. The election of the two professors came off about a month since. Dr. G. M. Humphry, F.R.S., of Downing College, was unopposed for the older professorship of human anatomy. For the other chair there were two candidates, Dr. Drosier of Caius College, and Mr. Alfred Newton of Magdalene, whose valuable ornithological researches are sufficiently well known. The latter gentleman was elected by a majority of 110 to 82.

The new museum of comparative anatomy at Cambridge—which has been erected within the last year by the University—contains a very valuable and select collection, and is now almost completely arranged, offering a further guarantee of the interest taken at Cambridge in the progress of biological science.

The publication of Professor Owen's work on the anatomy of the vertebrates is an event of some interest; two volumes have appeared, and the third has yet to come.

M. Edmond Alix describes the organs of parturition in Bennett's Kangaroo (*Hilmaturus Bennettii*). He seems to have satisfactorily determined that the view put forward by Sir Everard Home (perhaps derived from John Hunter) with regard to the communication between the cavity of the median vagina and that of the uretogenital vestibule is correct, and that both Cuvier and Owen have been wrong in denying it. M. Alix claims for M. Jules Verreaux the discovery of the mode of parturition in the kangaroo.* Mr. Verreaux kept a large number of these animals in captivity, and by attentive care day and night he was able to ascertain the following facts. When the female feels that she is about to expel an embryo, she applies her two anterior paws to each side of the vulva, so as to open its lips; then she introduces her muzzle, and receives the

* See also our last Chronicle for an account of the parturition of the opossum, which appears to differ very materially.

embryo into the buccal cavity. The aperture of the marsupial pouch is then opened by the paws and the embryo dropped into it from the mouth, when it soon attaches itself to the mammary gland. Both Owen and Bennett had guessed these facts, but M. Verreaux was the first to observe them.

Dr. J. E. Gray has received a letter from Dr. Hermann Burmeister, of Buenos Ayres, communicating the discovery of a new Cetacean, intermediate in character between the remarkable genera *Hyperoodon* and *Ziphius*. The new dolphin is to be called *Ziphiorhynchus cryptodon*.

An Italian frigate of war sailed shortly after Christmas last on an expedition to Siam and other countries, partly for the purpose of forming treaties of commerce, but also with the object of scientific discovery. The naturalists on board are Professor de Filippi of Turin and Dr. Henry Giglioli of Pisa, who was lately studying science in this country. The vessel has touched at Buenos Ayres and Monte Video, where the naturalists made some explorations into the interior and obtained several new species of birds and *Lepidoptera*. The pelagic animals obtained on the voyage were many of them new. The 'Magenta' is now on her way to Singapore.

Professor Agassiz is apparently meeting with great success in his expedition to the borders of the Amazon. He has more than tripled the number of species of fishes known in the Amazon and its tributaries. He has also discovered many new generic forms, and has established various remarkable physiological facts, such as the incubation of the eggs of several species of the family of the Chromidæ. In a letter from him, dated Ega (Amazons), 22nd September, 1865, he says:—"I have observed a species of *Geophagus*, which I have described under the name of *G. Pedroinus*, the male of which carries on its snout a very prominent knob, which is entirely wanting in the female and young. This same fish has a most extraordinary mode of reproduction. The eggs pass—I don't know how—*into the mouth*, the bottom of which they cover, between the internal appendages of the branchiæ, and especially in a pocket, formed by the superior pharyngians, which they completely fill. There they are hatched, and the young, free of their shell, continue to grow until they are in a fit state to take care of themselves. I don't know how long this takes, but I have already met with examples, in which the young were no longer provided with the vitelline sac."

M. Charles Robin, the distinguished physiologist, has been elected a Member of the Academy, in the section of Anatomy and Zoology, to supply the vacancy caused by the death of M. Valenciennes. The other candidate chosen for ballot was Dr. Lacaze Duthiers.

M. Aug. Dumeril lately communicated to the French Academy

a note on the Lepidosirens (*Protopterus annectens* of Owen), which have been living in the Menagerie of the Museum of Natural History. Up to the present time, the only period at which the Lepidosiren had been observed was when it quitted the peculiar cocoon of mud—formed by itself—in which it was frequently brought to Europe from the Senegambia. M. Dumeril has had the opportunity of observing the animal form its cocoon, and by producing an artificial "drying up" of the aquarium in which the Lepidosirens were kept, has succeeded in imitating the conditions under which they are met with in the African rivers. He establishes the facts, that the cocoon is used as a protection under these circumstances, and is formed by a copious secretion of mucus from the surface of the body, and has no vegetable matters in it. The fish fed on earth-worms, and the peculiar cry, observed already by Mr. M'Donnell of Dublin, was uttered by one of the specimens at the Jardins des Plantes, when a portion of its cocoon had been broken.

The remarkable researches which have been going on during the last year in Germany, relative to the asexual reproduction of the larvæ of flies belonging to the genus *Cecidomyia*, are well worth the attention of all English naturalists; and it ought not to be long ere some of our own observers add their testimony to the evidence accumulated by our laborious continental friends. The first observations made on this subject were not published for some two years after they had been made, since the facts recorded by the naturalist who observed them appeared to the editors of the 'Zeitschrift fur Wissenschaftliche Zoologie' to be almost incredible. It was in the winter of 1861–1862, that Professor Wagner of Casan communicated to Von Siebold some very remarkable observations on the reproduction of certain insect larvæ. These larvæ he found in great numbers in the bark of a dead elm-tree, and observed that they were filled with other smaller larvæ, which completely resembled them. He at first thought this a case of parasitism; but afterwards came to the conclusion that he had here an instance of reproduction by insects which were themselves *larvæ*. Professor Wagner carefully followed up his first observations, and described in detail the larvæ and the perfect insect. This case of "alternation of generations," as it is called, Herr Wagner considered a simpler one than that of the Aphis. He compared it to the propagation of the Cestode and Trematode worms, basing his analogy on the fact that in the Dipterous larvæ he had not discovered special organs of reproduction. Professor Pagenstecher of Heidelberg then published some researches on the larvæ of an allied insect; he was able to confirm the general accuracy of Professor Wagner's conclusions, but differed from him with regard to the production of the germs and a few other details. The larvæ observed in this case were obtained in immense

numbers from the refuse of some sugar works, associated with *Anguillula, Podura,* and other vermin. They belong to the genus *Sciara,* and it is worth noting that these observations were made at a distance of some 350 leagues from the locality of Professor Wagner's researches. Professor Pagenstecher described most minutely the anatomy of these larvæ. He differed from Professor Wagner as to the nature of the fatty bodies, and believed that the germs are formed independently of these bodies, but afterwards assimilate them as other nutritive matters. The exact position in which the eggs are developed he could not ascertain, but it appeared to be near the junction of the Malpighian vessels with the intestine. The gradual growth of the young larvæ inside its parent he most carefully describes, and it appears to moult while still in the egg; meanwhile the parent larva moves less and less, but still remains well and living, though largely distended. At length she assumes a new skin, which is harder and more chitinous than the last. The young, who have now escaped from their eggs, commence to devour her viscera, and at last finish by reducing their parent to the condition of a yellow larval skin filled with young grubs, which shortly escape. Professor Pagenstecher had no doubt that a complete analogy exists between this case of parthenogenesis and that of *Aphis,* and hence differed from Professor Wagner. On the 2nd of March last year a paper by M. Hanin of Charkow, on this same subject, was read at the Academy of Sciences of St. Petersburg. The larvæ he had studied were found under the planks of a house in the *débris* of various edibles. M. Hanin has verified Professor Pagenstecher's opinion that the ovules are produced by special organs; they are not simply developed in the corpus adiposum, but are produced in little sacs, to which he gives the name of ovaries. It must be remembered, at the same time, that these ovules or eggs are *pseudova,* and not true *ova,* as far as we know. M. Hanin's paper is especially valuable on this account, that he describes the development of the pseudova, and thus completes the history of this very remarkable case of agamic reproduction.

Dr. Lacaze-Duthiers describes a new and very remarkable genus of Ascidians in a late number of the 'Annales des Sciences Naturelle,' for which he proposes the name *Chevreulius.* There can be little doubt, as the author remarks, that this genus will form the type of a new group of Ascidia. It presents the very peculiar character of an Ascidian with a bivalve test, and hence offers an approach to the Brachiopoda in its external conformation; the lower valve being much the largest, and not differing much in appearance from that of some Thecidia. The minutest details of structure and life-history are given by M. Duthiers in this most elaborate essay on the genus. The chief point of interest in the little Chevreulius is the confirmation which it affords to the opinion of Messrs. Huxley

and Hancock, that "the Ascidians, Brachiopods, and Polyzoa present a number of common characters." The indefatigable manner in which this naturalist is working is really such as to call forth some acknowledgment from us. During the past year he has published a very large number of most valuable papers and essays in both the 'Comptes Rendus' and the 'Annales.'

M. Balbiani records some very curious observations on the eggs of various Invertebrata, in the 'Comptes Rendus' for December. He states that he has observed canals traversing the substance of the vitellus, and in connection in some forms with the contractile vesicle which he discovered some time since. M. Balbiani's observations are so very remarkable that it is difficult to receive them with full assurance until they have been confirmed by other observers. He endeavours to point out that in ordinary animal cells there exists a contractile vesicle and canals connected with it, similar to the contractile vesicle and canals of the Infusoria. The author's observations were made principally on the eggs of *Geophile longicornis*, but also on those of the Dog, Ray, Batrachians, Annelids, Turbellarians, and Mollusca.

Phthiriasis and the *Pediculi* may not appear to be very inviting objects of study, but at the same time, it would have been expected that the anatomy of the Louse had been completely made out by the researches of some of our early microscopists. Leeuwenhoek, in 1694, remarked, "Præterea pro certo habentes adhuc millenas in capite pediculi esse res, quæ oculos nostros semper latebunt," and it appears that he was right; for, even with the microscopes of the present day, the mouth of the louse still remains a subject of discussion. The valuable series of papers of Dr. Leonard Landois, in Kölliker's 'Zeitschrift,' have brought the anatomy of these interesting parasites again before the notice of zoologists, and now we have a paper by Professor Schjödte, of great value, published in the Danish language, but happily translated by Mr. Dallas in the 'Annals of Natural History' for March. The earliest observers concurred in regarding the louse as a blood-sucking parasite, provided with a haustellum and not capable of inflicting a bite. Erichson, Simon, and Landois, however, contend that there exists a pair of horizontally working mandibles, true organs of biting, both in *P. capitis* and *P. vestimenti*, and in *Phthirius inguinalis*. Some cases of phthiriasis are brought forward by Dr. Landois in his papers to support this view. Professor Schjödte, however, attacks this opinion very vigorously, and points out that the three authors who support the biting theory have been misled by their method of examination, which has led them into discrepancies with regard to the existence of "hooks" or "palpi." Our author remarks that, according to these three authorities, we have a mouth consisting of the following parts:—(1) an haustellum, according to Erichson and Simon, provided

with a pair of four-jointed palpi, but according to Landois, exhibiting a bifid labrum armed with hooks at one extremity, and reaching with the other far back into the head; (2) a pair of mandibles *underneath* the haustellum. This type of mouth differs fundamentally from that of all known arthropods; moreover, the so-called mandibles are totally devoid of muscles, and the pointed narrow form of the head in the louse is not such as to give support to biting organs. Professor Schjödte objects altogether to the mode of examination —that of cutting off the head and squeezing it flat on glass,—by which Landois and others have made their observations; for when the head is examined from beneath by reflected light without pressure, the so-called mandibles are seen to be *within* the skin, and, therefore certainly are *not* mandibles. He then describes how he observed the little lice, as did old Swammerdam, by letting them quietly feed on his own hand after keeping them hungry for a day or two, protruding their *haustella*, and sucking vigorously at the blood, while a pumping action was visible in the æsophagus, and the intestines worked with a regular peristaltic action. Lice are, according to our author, to be considered merely as bugs, modified to suit their position in life, their mouth being of the true Rhyncote type. Swammerdam, who wrote more than a century since, appears to have been almost exact in his description, and observed the small pumping ventricle at the base of the haustellum, which Schjödte again describes, whilst, with evident enthusiasm, he commends the writings of Swammerdam to his readers' study.

The microscopic examination of the fibres of meat cut from animals which had died of the cattle plague, has brought an interesting parasitic structure again before the notice of naturalists. In the ultimate fibres of the muscles of such animals, and also more rarely in healthy individuals, exceedingly minute, elongated, saccular bodies with granular contents, and a finely fringed envelope, are to be observed; and there has been much question as to whether these are entophytes or entozoa, or anything else. Meisner appears to have first described such bodies in 1839, having observed them in the muscles of a mouse. The best account of them, however, is that of Rainey, in the 'Philosophical Transactions of 1857,' who, though he mistook them for the young forms of cestoid entozoa, described them very accurately, and observed that they gave rise to smaller ovoid bodies, which he carefully figures. These observations were made in the pig. There can be little doubt that the parasites are *Gregarinæ*, and that the smaller ovoid bodies are their "psorosperms" or "pseudo-navicells," though Dr. Beale and Dr. Spencer Cobbold, who have lately been examining those from the cattle-plague meat, do not give a definite opinion. The most unpleasant part of the matter is, that we are all probably frequently eating these minute parasites without being aware of it; and may,

perhaps, be unconsciously infested by them ourselves, since they do not produce any apparent symptoms in the animals in which they occur.

Zoological Society of London.—This Society has lately obtained one of the curious eared seals (Otaria) for its menagerie, probably an individual of the *Arctocephalus Hookeri* of Dr. Gray. It was brought from Cape Horn. Mr. T. Davidson, F.R.S., has communicated some notes to the Society on recent Brachiopoda dredged by the late Lucas Barrett off Jamaica. Five species were described in this paper, three of which were considered to be new to science.

Mr. Flower has read the first part of his memoir upon the osteology of the sperm whale (*Physeter*). Mr. Flower's observations were based principally upon a nearly perfect skeleton of this animal lately received by the Royal College of Surgeons from the coast of Tasmania, and upon a skeleton recently obtained by the British Museum from the north coast of Scotland. Other specimens in various European collections had also been consulted when available. In the present communication, Mr. Flower confined his remarks to the vertebral column of this huge animal, which was described in detail.

A communication has been made by Professor Baird, of the Smithsonian Institution, Washington, containing some notes on the habits of the American Prong-Buck (*Antilocapra Americana*) by Dr. C. A. Caufield, which had been addressed in a letter to Professor Baird, from Monterey County, California, in September, 1858. Dr. Caufield's notes tended to show that this animal sheds its horns periodically, and thus confirmed Mr. Bartlett's observations, made upon this animal from the example living in the Society's Gardens, which had been reported to the Society at one of their previous meetings.

Mr. P. L. Sclater has read a paper upon the genera and species of Caprimulgidæ belonging to the New World, commencing his communication by some preliminary remarks on the general arrangement of the whole family and its geographical distribution. Mr. Sclater proposed to divide the family Caprimulgidæ into three sub-families,—1. *Caprimulginæ*; 2. *Steatornithinæ*; 3. *Podarginæ*, —and showed that each of these groups possessed very distinct characters, which might almost entitle them to rank as three different families. As regards the American Caprimulgidæ, Mr. Sclater was acquainted with about forty well-distinguished species of this group belonging to the New World, amongst which was one from New Grenada, considered to be new to science and proposed to be called *Stenopsis ruficervix*.

Quarterly List of Publications received for Review.

1. The Treasury of Botany; a Popular Dictionary of the Vegetable Kingdom; with which is incorporated a Glossary of Botanical Terms. Edited by John Lindley, Ph.D., F.R.S., and Thomas Moore, F.L.S., assisted by Numerous Contributors. In Two Parts. With *Steel Plates and Wood-engravings.* 1270 pp. Fcap. 8vo. *Longmans & Co.*

2. On the Anatomy of Vertebrates. Vol. I.—Fishes and Reptiles. By Richard Owen, F.R.S., Superintendent of the Natural History Departments of the British Museum. 452 *Wood Engravings.* 690 pp. Demy 8vo. *Longmans & Co.*

3. Reliquiæ Aquitanicæ; being Contributions to the Archæology and Palæontology of Perigord and the adjoining Provinces of Southern France. By Edouard Lartet and Henry Christy. Part I., December, 1865. *Plates and Wood Engravings.* Royal 4to. *From the Executors of the late H. Christy, Esq.*

4. Pre-historic Remains of Caithness. By Samuel Laing, M P., F.G.S. With Notes of the Human Remains, by Thomas H. Huxley, F.R.S. *Plates and Wood Engravings.* 160 pp. Demy 8vo. *Williams & Norgate.*

5. The Year-Book of Pharmacy: a Practical Summary of Researches in Pharmacy, Materia Medica, and Pharmaceutical Chemistry during the year 1865. Edited by Charles H. Wood, F.C.S., and Charles Sharp. 175 pp. Crown 8vo. *John Churchill & Sons.*

6. The Geology and Scenery of the North of Scotland; being Two Lectures given at the Philosophical Institution, Edinburgh. By James Nicol, F.R.S.E., F.G.S., Professor of Natural History in the University of Aberdeen. 96 pp. Fcap. 8vo. *Oliver & Boyd.*

7. On the Nature, Cause, and Treatment of Tuberculosis. By Horace Dobell, M.D., Physician to the Royal Infirmary for Diseases of the Chest. 90 pp. Crown 8vo. *John Churchill & Sons.*

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8. Guglielmo Rossi. Sulle Istituzioni di Istruzione primaria nella Lombardia, e in particolare nel Circondario di Monza. Allocuzione Storico-statistica. Seconda Edizione. 100 pp. 4to. *Milano : Pietro Agnelli.*

9. First List of Flowering Plants and Ferns found within four Miles of the Close, Rugby. By F. E. Kitchener, Assistant-Master, Rugby School. 16 pp. 8vo. *From the Author.*

10. A Dictionary of Science, Literature, and Art; comprising the Definitions and Derivations of the Scientific Terms in general use, together with the History and Descriptions of the Scientific Principles of nearly every Branch of Human Knowledge. Edited by W. T. Brande, D.C.L., F.R.S., and Rev. George W. Cox, M.A. Part VIII. *Longmans & Co.*

11. The Danger of Deterioration of Race from the too rapid Increase of Great Cities. By John Edward Morgan, M.A., M.D. Oxon., Physician to the Salford Hospital. 60 pp. Fcap. 8vo. *Longmans & Co.*

PAMPHLETS, PERIODICALS, PROCEEDINGS OF SOCIETIES, &c.

Geological Map of England and Wales. By Professor Ramsay, F.R.S. *Stanford.*

The Stars, in Twelve Maps on the Gnomonic Projection, collected, in duplicate, in four plates. By Richard A. Proctor, B.A. 4to. *Longmans & Co.*

Programme de la Société Batave de Philosophie Expérimentale de Rotterdam.

The Cry of the Dumb. 20 pp. Crown 8vo. *Nisbet & Co.*

The Action of Vegetable Fungi in the Production of Measles and allied Diseases. By Tilbury Fox, M.D., London. 8 pp. 8vo. *From the Author.*

The Nature of so-called Parasites of the Skin. Same Author.

Cholera Prospects. Compiled from Personal Observation in the East. Same Author. *Hardwicke.*

A Letter to the Provost of Oriel, on University Extension. By Charles Daubeny, M.D., F.R.S. *Parker.*

Notes on some Birds inhabiting the Southern Ocean. By F. W. Hutton. *Natural Hist. Society, Dublin.*

The Celebrated Theory of Parallels. By W. Matthew Ryan, Washington.

The Pestilence. Why Inflicted: Its Duration, and Desolating Character. By James Biden. 24 pp. Demy 8vo.
Gosport: J. P. Legg.

Comparative Anthropology of England and Wales. By D. Mackintosh, F.G.S. *Trübner.*

Treason; or, the Image of the Beast. 28 pp. 12mo.
From the Author (U.S.A.)

Reports on Petroleum as a Fuel. Experiments made at the Morgan Iron Works, New York.

Annual Report and Transactions of the Plymouth Institution, and Devon and Cornwall Natural History Society, 1864-5. 115 pp. Demy 8vo.

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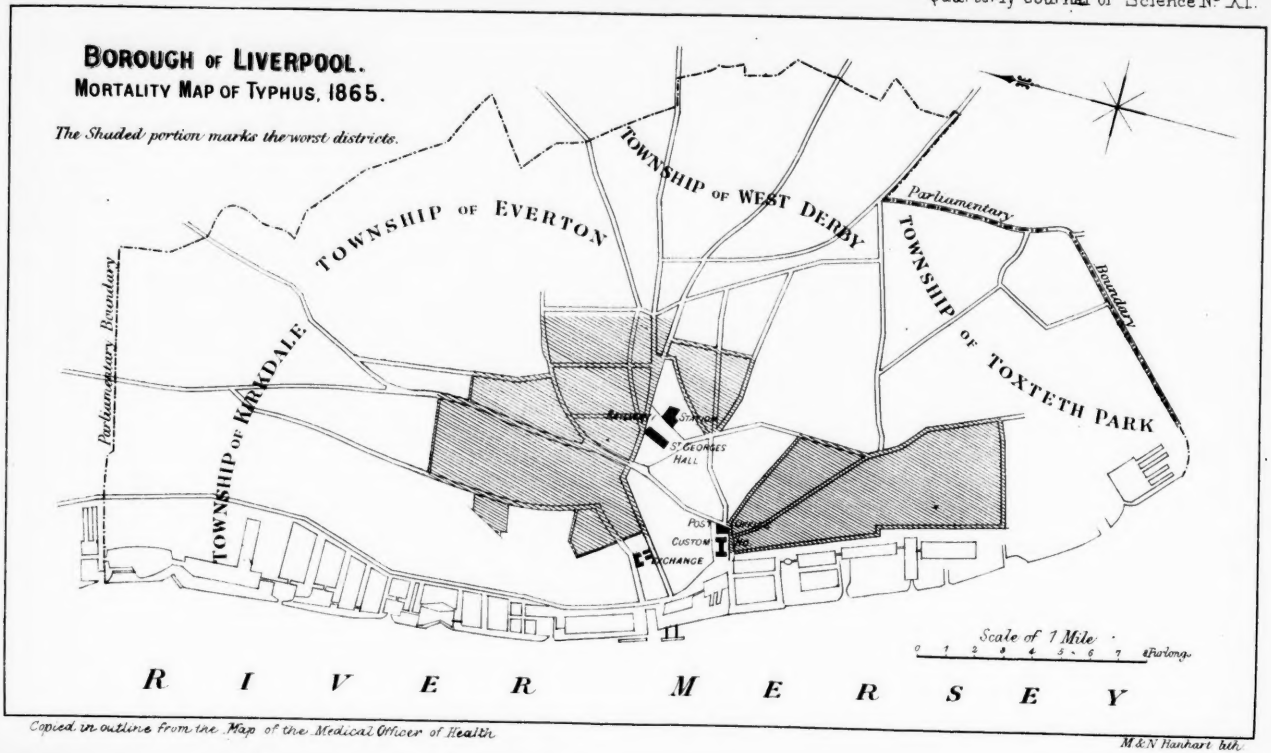
BOROUGH OF LIVERPOOL.
MORTALITY MAP OF TYPHUS, 1865.
The Shaded portion marks the worst districts.
TOWNSHIP OF EVERTON
TOWNSHIP OF WEST DERBY
TOWNSHIP OF TOXTETH PARK
TOWNSHIP OF KIRKDALE
Parliamentary Boundary
Parliamentary Boundary
St GEORGES HALL
CUSTOM HOUSE
EXCHANGE
Scale of 1 Mile
0 1 2 3 4 5 6 7 8 Furlongs
RIVER MERSEY
Copied in outline from the Map of the Medical Officer of Health
M&N Hanhart lith.